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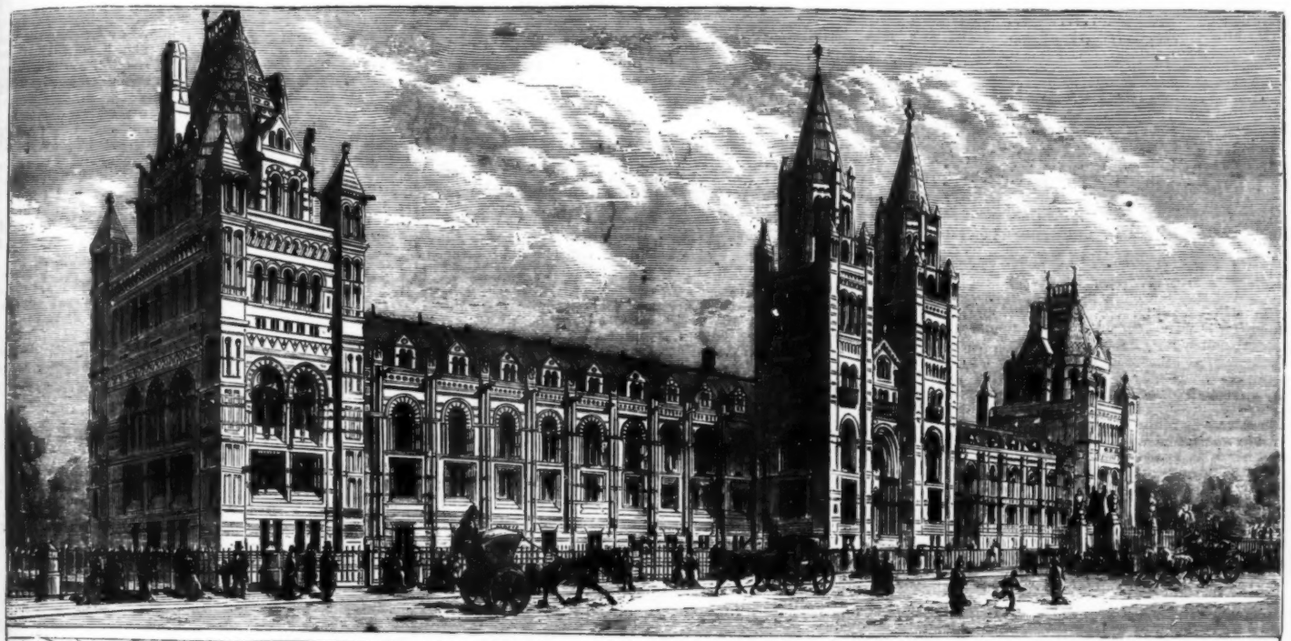
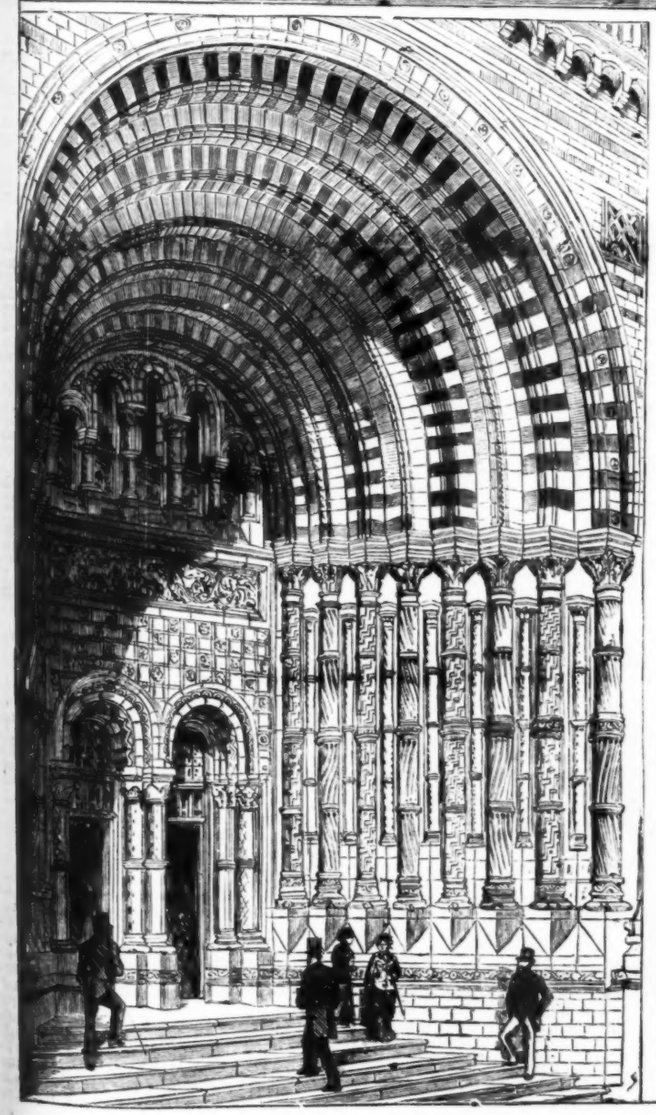




1. South Front. 2. Principal Entrance. 3. Gallery to "Index Museum." 4. Entrance Hall to "Index Museum."

## THE ZOOLOGICAL MUSEUM AT SOUTH KENSINGTON, LONDON.

## TESTS OF A SMOKE CONSUMING FURNACE.

DURING the recent Industrial Exhibition at Pittsburg, Pa., the smoke consuming furnace invented by Dr. H. L. Pierce, of Grand Rapids, Michigan, was subjected to a series of test experiments by a committee of scientific and mechanical experts appointed for the purpose. The tests were made in the Exposition building, Sept. 26. The report of the committee states that when the experiment began the fire was in good condition and the water stood above the second gauge cock. At the end of the experiment the fire was as nearly as possible in the same condition as at the beginning. When the experiment was ended the fire was cleaned out and the ashes, cinders, and clinkers were weighed. During the experiment the temperature of the rear of the first and third boilers and of the uptake was registered every fifteen minutes, and the coal and water used were carefully measured. The results of the day's experiments are as follows:

| | |
|---|---|
| Duration of experiment | 3 hours. |
| Grate area | 32 sq. ft. |
| Evaporating surface | 910 ft. |
| Pounds of coal fed to furnace | 1,557 |
| Pounds of ashes and refuge | 235 |
| Pounds of combustibles | 1,322 |
| Water fed to the boilers | 9,854 pounds. |
| Pressure of steam | 105 " |
| Temperature of feed water | 63° |
| " " chimney gas | 524° |
| " " atmosphere | 64° |

ECONOMIC PERFORMANCE.

| | |
|---|---|
| Pounds of water evaporated per pound of coal from 63° | 6·33 |
| Pounds of water evaporated per pound of coal from 212° | 7·55 |
| Pounds of water evaporated per pound of combustible from 63° | 7·45 |
| Pounds of water evaporated per pound of combustible from 213° | 8·89 |
| Percentage of ashes and refuse | 0·15 |

The combustion of the fuel and gases was perfect and no smoke was produced. After the experiment was finished, the boilers were carefully examined inside and outside. On the outside was found a whitish gray deposit one sixty-fourth (1-64) of an inch thick. In the flues was found a light, dry, flaky soot, which apparently contained no oily matter. With these exceptions the boilers and flues were found to be clean and in good condition. While the furnaces were built to employ heated air, none was used during this experiment.

A furnace of the same construction was tested at the chemical works at Bangor, Mich., August 2, 1879.

It was under a new boiler, 5 feet in diameter, 16 feet in length, containing 54 three-inch tubes, with a grate surface of 16 1-5 feet. The boiler with which the new furnace was compared was a boiler of the same manufacture and same dimensions, with same surface exposed to the fire, with 24 1-5 feet of grate surface, and had been in use two years, and was in good order, and was set after the usual manner of setting boilers.

Test No. 1 was to ascertain comparative amount of wood consumed in equal time by the two boilers when doing equal amounts of work under equal pressure.

Fuel—seasoned maple wood of first quality.

| | |
|---|---|
| Length of test | 6 5-60 hours. |
| Old furnace consumed | 3,520 pounds. |
| New furnace consumed | 2,820 " |
| Difference favor of new | 700 " |
| Saving in favor of new | 20 per cent. |
| Steam pressure on each boiler | 70 pounds. |

Some smoke from old furnace.
No smoke from new furnace.

TEST NO. 2.

Evaporative power of new boilers.

| | |
|---|---|
| Time of test | 4 45-60 hours. |
| Coal consumed (Pittsburg coal) | 798 pounds. |
| Pounds of water evaporated | 8,790 |
| Pounds of water evaporated to each pound of coal | 11 |
| Pressure of steam | 50 pounds. |
| Temperature of water as fed to boilers | 80° |

No allowances were made for temperature or refuse. No smoke from furnace.

Test No. 3, showing comparative quantity of Pittsburg coal consumed by the two boilers in equal time when doing equal amount of work under equal pressure:

| | |
|---|---|
| Time of test | 2 hours. |
| Old furnace consumed | 482 pounds. |
| New furnace consumed | 326 " |
| Less amount consumed by new furnace | 156 " |
| Saving in favor of new furnace | 30 9-10 per cent. |

A little smoke from new furnace at starting, none afterwards. Smoke from old furnace as usual.

On October 1, 1879, a test of the evaporative powers of the boilers set after the ordinary method and in use at Davis Dam was made. There were present Lieut. F. A. Mahan, U. S. A.; H. M. Pierce, LL.D.; John R. Meredith, Master Mechanic; Wm. B. Rogers, Engineer; Dennis Church, M.D.; Samuel S. Fuller, and E. H. Harding. The experiments were conducted by Mr. Wm. Meredith, Mr. Rogers, and Dr. Church, Mr. Harding keeping the record.

The result of the experiment is as follows:

| | |
|---|---|
| Length of time of test | 2 hours. |
| Grate area | 72 feet. |
| Evaporating surface | 1,506 sq. feet. |
| Pounds of coal fed to furnaces | 2,475 |
| Water fed to the boilers | 12,520 pounds. |
| Pressure of steam | 105 " |
| Temperature of feed water | 60° |

ECONOMIC PERFORMANCE.

| | |
|---|---|
| Pounds of water evaporated per pound of coal from 60° | 5·06 |
| Pounds of water evaporated per pound of coal from 212° | 6·04 |

The fire at the close of the test was as nearly as possible in the same condition as at the beginning. The water was kept above the second gauge. As much smoke as is usual with boilers set in the ordinary way issued from the stack during the test.

The superior economy of the Pierce furnace indicated by these tests is sustained by the testimony of the general manager of the Pittsburg Exposition Society, who states that the fuel economizer used under the boilers of the Exposition not only gave entire satisfaction by consuming the smoke, but also made a large saving in fuel. To heat the same boilers last year required 136¼ bushels of coal a day; this year, under the new process, there were required from 82 to 85 bushels a day. The people of Pittsburg appear to be well pleased with the prospect of abating the great smoke nuisance so economically.

## GAS STOVES.

AT a recent meeting of the Philosophical Society at Glasgow, Dr. James Adams, F.F.P.S.E., read a valuable paper on "Improvements in Gas Stoves."

In the course of his remarks Dr. Adams said—Twenty-five years ago I read to the Glasgow Medical Society a communication on "Heating by Gas," and exhibited a stove made to my design. In my belief that stove surpassed anything since open to public observation. But it was liable to drawbacks, which I then failed in overcoming, and I put aside my conception. I retained, nevertheless, the desire to see it realized, being sensible that I had made a substantial step in advance, and I have informed myself and noted with interest all that has since been done in this connection. About eighteen months ago I re-entered with zest upon a practical investigation, feeling assured that the principles were sound that I had assumed for my guidance, and had partially embodied in my infant conception. I will now bring under your consideration a practical illustration of those principles. Coal-gas is not of uniform composition. It is a mixture of gases and of vapors, the numbers, qualities, and proportions of which vary in every locality where coal-gas is manufactured for public use. Its most abundant constituents are compounds of carbon and hydrogen, the latter forming the bulk of the mixture. However carefully manufactured, impurities are always present, which, together with the gaseous waste products of combustion, should never be permitted to accumulate in the air of dwelling apartments. When coal gas is burned its constituents are transformed into other gases and vapors. On this point there is much popular ignorance. Because no smoke and little or no odor may be perceptible it is assumed that the combustion has left behind it nothing injurious. There is a hazy conception that perfect combustion means something like practical annihilation. But, in point of fact, the invisible, mal-odorous, inflammable gas has been merely transformed into invisible, non-odorous non-inflammable gas. The carbon has united with oxygen of the air and formed carbonic acid, a deadly poison is inhaled pure, and the hydrogen has united also with oxygen of the air and formed watery vapor, whilst a large quantity of nitrogen has been set free from the air. But if combustion has not been perfect, there is formed in addition to carbonic acid, another still more poisonous gas called carbonic oxide. The common-sense deduction is that all gas stoves should be provided with flues to carry off the waste products of combustion into a chimney. The several properties through which heat is communicated, viz., conduction, convection, and radiation, have each their special value and appropriate use, and ought to be carefully considered, so as to best insure the maximum intensity of each property as well separately as in combination. By accurate observers it has been determined that about three-fourths of the heat of an open fire consists of the heat of convection, nearly all of which passes up the chimney, leaving only a fourth to be utilized as radiant heat. When coal-gas is used as fuel, and the ordinary jets for lighting purposes are employed, the convected heat generated amounts to 84 per cent., or five-sixths of the entire heat, and only 16 per cent., or about one-sixth is given out as radiant heat. When the Bunsen burner in any of its forms is employed, the heat generated is nearly altogether that of convection, only about 6 per cent. consists of radiant heat. This question of the influence of solid particles in a flame was worked out and is recorded by Tyndall in his "Contributions to Molecular Physics in the Domain of Radiant Heat." Using an apparatus of exceedingly sensitive precision, furnished with a dial index that noted the degrees of force—not of heat—he found that the radiation from the luminous gas flame was fully two and a half times that from the non-luminous flame. The degree of force noted in the luminous flame was 30°, and the radiation fell to a force of only 12° the instant the flame became non-luminous. But by introducing solid mater the radiation originating in the hydrogen, or non-luminous flame, became so intense that a spiral platinum wire plunged in the former brought up the index to 200°. That is, there was instantly generated an amount of radiant heat more than six times that of the luminous gas flame, and more than thirty times that of the non-luminous flame. To obtain in a practical form the means of converting the heat of convection into the heat of radiation, and when converted, of practically utilizing the same, has been the chief aim of my efforts for the improvement of gas stoves; and my argument is now sufficiently advanced to enable me to refer to the methods I employ, and through which I have obtained my object. I employ in gas-heating stoves a burner consisting of a group of hollow perforated tubes of fireclay, supplied internally with a mixture of gas and air, which passing through the perforations, burns on the outer surface. These fireclay tubes are inclosed in a case or chamber which prevents free access of air to their exterior, where combustion takes place, but by perforations a small quantity of air is admitted, which ascends within and between the tubes and insures complete combustion. Thus only the smallest practicable excess of unconsumed air is permitted to mix with the products of combustion. The products of combustion are led to a chimney by a flue of peculiar construction, in which they are detained until they have parted with all their available heat; and other channels or ducts lead currents of pure air along the heated walls of the flue channel, and the air, so warmed, is allowed to re-enter the room in which the stove is used. The walls of the air-channels or ducts, and generally the casings of the stove, present an extensive surface to take up the heat from the products of combustion traversing the flue channel, and consequently these surfaces do not become over-heated. The air entering the stove is caused to pass in at or near the top, and thus a supply free from dust is insured, and draughts along the floor of the apartment are avoided. The warm air issuing from the stove is caused to pass over water contained in a trough, so formed that by filling it more or less the surface of water exposed to the warm air may be varied in extent. Lastly—not to dwell on too many points—provision is made by which the risk of explosion is entirely obviated.

## DARKE'S INDICATOR.

MR. E. T. DARKE'S experience in indicating quick-running engines proved to him the absolute necessity of some improvements in the lightness of the pencil motion and moving parts generally of the steam engine indicators, for it is an admitted fact that satisfactory diagrams from engines running over a certain and very moderate speed cannot be obtained by the most careful and intelligent use of the Richards indicator, which is certainly the best of any which has made its appearance to the present time.

The illustration of this new indicator given opposite, will, we think, interest many of our readers. In this instrument every possible means has been adopted to lessen the weight, and, consequently, the momentum of the moving parts. In the first place, the whole indicator has been reduced to about the half of the size of the Richards form. The piston, instead of being one-half of a square inch in its area, is one-quarter. If this reduction of piston area is open to objection, it must be borne in mind that the object of the inventor was to produce a readable diagram, and it is questionable if that object can be attained by keeping the piston the old size and weight; and it must be also remembered that this smaller size was used in the old McNaught indicator, and also that if there really is a disadvantage in using a smaller area than that of the Richards piston, that disadvantage may be compensated by the area of the piston being nearer to the area of the steam supply pipe. The spring is of a smaller diameter from center to center of wire, which enables a much lighter spring to be used when indicating equal pressures; the piston rod is made hollow, and is also lightened by its shorter length and lesser diameter. The stroke of the piston is from ¼ inch to ⅜ inch, and this motion being multiplied by four, the stroke of the pencil is about 1½ inches, while the greatest length of diagram is 3½ inches.

A great improvement in this indicator is the pencil motion, which is made of one piece of steel fitted at the one end to a crosshead, which crosshead is supported and moves upon steel centers, and at the other carries a little sliding block through which the pin (or pencil, as it may be called) passes; the pin moves upon the paper drum through a slot or guide (which is a part of the swivel top of the indicator cylinder); the little sliding block upon the arm moves upon the lever as a pin moves in a straight line in the slot or guide. The piston-rod head carries a jaw, in which moving also on centers is a light sleeve through which the pencil arm passes, sliding in this sleeve as the angle of the pencil arm varies with the stroke of the piston. An examination of the instrument will show that every possible care has been taken to avoid "back-lash" at this most important part of the piston-rod head. This light pencil arm not only obtains a considerable stiffness from the long crosshead, but also from the piston rod, the long stalk of the jaw, and the absence of any leakage, rendering great resistance to the pressure caused by the pencil. The theory of this motion is perfect, and in practice it is found to be much more simple of manufacture, lighter, and more accurate than the Richards motion. The illustrations of the indicator on the following page will explain the construction clearly.

It will be observed that another arrangement of swivel is adopted for the cylinder head. In it slackness is again obviated by the pressure of a brass disk upon a ring which carries the lever crosshead centers and guide. This arrangement renders the spring more easily exchanged and cleaned than in the Richards form.

Another new feature in this indicator is the paper drum, the spring of which is placed at the bottom so that the drum is made available for the reception of the indicator paper, which is placed in the interior in a roll, or continuous sheet, and may be drawn out through a slot at the sides as required and torn off when a diagram has been taken, though ordinary paper may be used, as in the old form.

We annex a *facsimile* of a diagram taken by this little indicator, Fig. 1 being a reproduction of one taken from the low-pressure cylinder of a torpedo boat; Fig. 2 is a reproduction of one taken with a Richards indicator from the same cylinder of a sister boat. It will be seen that Fig. 2 is quite unreadable, and that Fig. 1 is really a very good indication of the action of the steam. We have inspected diagrams taken with this small indicator from a Corliss engine. In some of these the pencil was suffered to remain upon the paper during twelve strokes of the engine in order to test the accuracy of the indicator, and the most close examination fails to detect this fact, as they appear to be diagrams taken from a few revolutions only. We have also seen other diagrams taken from a full sized indicator fitted alternately with the Richards motion and one of the new form in which the superior action of the latter is very apparent.

There are included in Mr. Darke's specification for the indicator we have described, first, an invention for giving motion to the paper drum by the means of rods, etc., in rigid communication with the engine, with means of stopping and starting the paper drum in a very simple and effective way. By the use of this arrangement all errors from the elasticity of cords are avoided. And, secondly, an apparatus by which the revolutions of the engine are marked upon the diagram at the same time as the diagram is being taken.—*Engineering.*

## SHALL THE MILLSTONE BE SUPERSEDED?

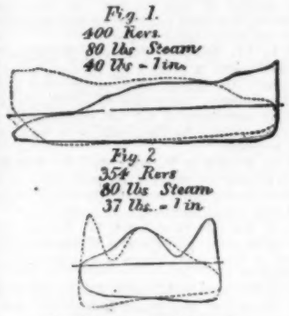
THE greatly improved methods of milling that in the past few years have been so universally adopted, have but stimulated a spirit of progress, and awakened a desire to attain still greater perfection in the art of flour making; and, in seeking now avenues for advancement in the science, it is but natural that the feasibility of improvement in the methods of reducing the wheat should be canvassed and discussed; and it is questionable if any topic now under consideration by the theoretic miller excites as lively interest, or one concerning which a greater diversity of opinion exists.

With the advent of "new process" milling came the necessity for improved methods of reduction, or rather improvements in the devices by which the reduction of the wheat berry was accomplished, and whether the full "high grinding" system, or its modification known as "half high grinding," was adopted as the practice, important changes in the dress and suspension of the burrs were essential to the successful realization of the object sought. At first, changes in the dress of the burrs were supposed to be sufficient, and innumerable "patent" dresses and others profoundly "secret" have at various times been offered the milling fraternity as embodying everything desirable to facilitate proper granulation. The necessity for having the burrs in proper tram and balance was recognized, and numberless devices were originated to ostensibly meet this requirement, but after protracted experience in the manu-

facture of the finest flour in the world (with one exception), the inevitable Yankee spirit of ambition to excel steps in and suggests possibly better results, by the adoption of another system, and the advisability of or probable benefit to be derived from a change of methods is now being agitated.

In past years numerous attempts have been made to obtain a substitute for the millstone, a substitute that would not when in operation become heated, that would not need dressing so often, and under the old system of milling, that would not paste so easily; but in this country very little attempt was made at the substitution of a device which should perform the function of flour-making in a mechanically different manner, until within the past three or four years.

With a view of arriving at an intelligent decision of this vexed question, let us consider the advantages and disadvantages of the time-honored millstone, as compared with




DARKE'S INDICATOR.

those of its (shall we say formidable?) proposed rival, the roller. It is hard to part with an old and tried friend under any circumstances, and still harder if, from lack of proper championship of his good qualities, he is banished to make way for one whose bad qualities may have been purposely or unwittingly concealed.

It is well to bear in mind in considering this matter, that the roller now clamoring for recognition from the American milling public, is an approved auxiliary of the Hungarian system, and that its results in practical operation in those countries where it has been most thoroughly tried are seemingly satisfactory, although scientific tests are constantly being made to still further increase its efficiency and value.

The demand of the miller belonging to the progressive school of to-day is, that in the reduction of the wheat berry the bran shall be kept in such large particles as to prevent its passing through the cloths in the processes of bolting, and this desirable result, it is claimed by many, cannot be accomplished by the agency of the millstone, because its tendency in operation is to rub and tear the berry apart, and as a consequence the bran is abraided and more or less reduced, so that minute particles are produced which it is found impossible to prevent becoming incorporated with the flour.

Again, it is said that this rubbing and tearing action disintegrates the germ, and it too passes into the flour product, causing it to assume a yellow cast, thereby injuring its commercial value.

It is further claimed by some that upon millstones all degrees of granulation are effected at a point about midway between the eye and skirt, and all frictional contact beyond that point is injurious, as the tendency is to produce a greater quantity of superfine flour, in addition to the liability of reducing the germ and bran.

It is urged that the amount of care and attention necessary in keeping the stones in proper condition, the power required to drive them, and their liability to derangement, more than counterbalance the difference in first cost as compared with rolls. To sum up the superiority claimed for the roller system of reduction we have:

1st. The bran and germ are better preserved.

2d. The product in the form of middlings, semolina, or flour will be freer from impurities.

3d. The effect of the pressure is to burst the berry, and in disintegration its granular formation is preserved.

4th. The flour obtained is not in the slightest degree heated.

5th. The flour will be more absorptive, and consequently the bread made therefrom will better retain moisture.

6th. As the degree of reduction can be regulated with the greatest accuracy, the middlings can be more easily and thoroughly purified.

7th. As the point of frictional action is reduced to the minimum, there is a perceptible decrease in the quantity of power necessary to perform the operations of granulation.

8th. Their remarkable durability as compared with the millstone.

9th. The time consumed in dressing the millstone is saved.

On the other hand some advocates of the retention of the millstone urge that, where care is taken to select close burrs, they properly dressed and the fittings as accurately and carefully constructed and arranged, equally as good if not better results will be obtained than by the employment of rolls.

It is claimed by some that the flour obtained by the roller system is coarser in texture than that produced on the millstone, and that for this reason the bread will not as well retain its moisture; that if the wheat is damp and tough it is necessary to thoroughly dry it before subjecting it to the process of reduction; that the middlings produced are not, by reason of their elongated shape, so readily purified; that the cost of operation is greatly increased; that the first cost is greater, and that much longer time is required in the operations of flour-making.

Now, if both sides to this question can adduce substantial proofs of the accuracy of all their statements and assertions, it will be evident that

1st. Both systems are the best, and

2d. Neither one is calculated to produce satisfactory results.

In 1876, all the great mills in Buda-Pesth had adopted the roller system of granulation, and it is to-day, probably, in greater favor than at any previous time, but the fact that in some of the mills as many as eleven grades of flour are made, would seem good ground for supposing that the system in its entirety could not be successfully introduced into this country.

The fact that constant experiments are being made there to devise other means of reduction, would also indicate that the system, although in use, leaves something to be desired.

Again, that the roll is not generally taken to be, theoretically, the best adapted for the first reduction, is shown by the fact that numerous cutting machines have been devised for this purpose; and that for "finishing up" it does not satisfactorily meet the requirements of millers is evidenced by the fact that in some of the leading mills in Austro-Hungary this operation is performed upon millstones.

A careful consideration of all the theories advanced, and facts obtainable having a bearing upon this question, leads to the following conclusions:

1st. Roller milling in a somewhat modified form might be profitably employed in this country in mills that now operate on strictly the "high grinding" plan, as in this system all operations may be performed upon rolls, except regrinding the bran.

We think it must be admitted that the cost of operation will exceed that of millstones, and certainly the first cost is greater, but, as there appears to be ample evidence that a greater percentage of high grade flour is obtainable from their use, the increased value of this product will probably more than counterbalance these objections.

The operations of reducing, scalping, purifying, and bolting consume more time, and the system demands more watchful care and attention than that now in vogue, but if adopted, as it bids fair to be in some of our large mills, we look for the happiest results.

2d. Rolls will be found valuable auxiliaries in half high grinding for the purpose of flattening the germ and middlings to which particles of bran adhere.

To perform this office, we look to see them almost universally employed, as for the purpose they have yet found no worthy competitor.

In discussing the probabilities of the millstone being discarded, and the roller adopted in the United States, it must be borne in mind that mills which pursue "high grinding" are few in number as compared with those that do not.

The great mills at St. Louis, whose products find ready market at home and abroad, and other well-known and extensive mills throughout Missouri, Wisconsin, Illinois, Michigan, Indiana, and other States where soft wheats are grown and milled, have not thought it economical or wise, in a commercial sense, to adopt the system of high grinding prevalent in those sections where hard wheat is obtainable, and so long as this is the case millstones will be employed and regarded with favor.

That changes will be made in them and their methods of operation, that their capabilities and value will be augmented is to be expected, as we are progressive in our ideas and aspirations, but the time when they will be entirely superseded is, we believe, far distant.—*Milling World.*

FIG. 3.—DARKE'S INDICATOR.—CONSTRUCTED BY MESSRS. ELLIOTT BROTHERS, LONDON.

## PROGRESS OF MILLING IN THE WEST.

A WESTERN trade journal gives figures to show the wonderful increase in the capacity of the flour mills of the Northwest during recent years:

"Up to 1876 the mills of New York, Pennsylvania, and the New England States made the great bulk of American flour. At that time new life seemed to be given to the interest in the States west of the Alleghanies. Within four years more than 2,500 mills have been erected in Indiana, Illinois, Wisconsin, and Minnesota, showing an annual increase of 250 mills! Of the 25,000 flour mills in this country, nearly half are northwest of the Ohio river, they manufacturing at least two-thirds of the whole amount of flour manufactured in the United States. In the past ten years the Northwest has doubled her number of flour mills and tripled her run of stone. Estimating the number of run of stone in the mills of Illinois, Wisconsin, Iowa, and Minnesota to be 10,400, each run consuming sixty bushels of wheat per day, we have a daily consumption of 217,000,000 bushels. Thus these four Northwestern States alone, if worked to their fullest capacity, could make 43,000,000 barrels of flour per year, or nearly seven-eighths of the entire flour product of 1878. The actual amount produced in 1879 by the mills of Minnesota was about 6,000,000 barrels. The mills of Illinois, Wisconsin, and Iowa have an aggregate production of 15,000,000 barrels, making a total of 21,000,000 barrels, nearly two-fifths of the product of the country."

## THE MANUFACTURE OF TOYS.

A CORRESPONDENT of the *Herald*, writing from Sonneberg, Thuringia, gives an interesting account of the development of the toy-industry of that region: Nuremberg has a greater reputation than Sonneberg for its toys, but this place has a far greater interest at Christmastide to Americans. Sonneberg exports all sorts of toys—trumpets and flutes, color boxes and fiddles, drums and harlequins, dolls' arms and legs, besides the completed article, musical boxes and stands, toy carts and horses, figures and animals on musical boxes and on bellows, toy birds and bird cages, animals and Noah's arks, toy stables and kitchens with appurtenances, woolly lambs and piping bullfinches, booths and shops, mechanical figures and regiments of soldiers, feathered poultry and puppet-show figures, bebe-dolls and glass eyes, marbles and dolls' voices—in fact, everything that can amuse and instruct the young people of a well-conducted nursery.

### ORIGIN OF THE INDUSTRY.

This Sonneberg toy industry is of great antiquity. It arose in the southwestern part of the Thuringian forest, belonging to the dukedom of Saxe-Meiningen, in the thirteenth century. It commenced with the manufacture of such common articles as wooden shingles, wooden household utensils, which the inhabitants of the mountain villages, mostly wood cutters and charcoal burners, used to produce in their leisure hours, their houses being surrounded by splendid groves of maple and beech, by fir and pine woods. Some of these poor mountaineers, as soon as the stock of their industrial labor had grown to a man's load, carried it away down to the lowlands of Franconia, returning to their homes only when the last article had been disposed of or exchanged for meal, flour, wool, cloth, or whatever they were in want of. This tedious mode of dealing was in those days a rather dangerous one, for it frequently happened that the poor laborers never reached their homes again, or if their lives had been spared by the highwaymen, they returned with empty pockets to their miserable cottages and wretched families. But in course of time the Thuringian forest was crossed by a highroad leading from Augsburg to Leipzig and Dresden. Caravans of Augsburg and Nuremberg merchants came this way, conducting their goods to the north of Germany, and bringing back other productions from there. The merchants noticed the diligence and ingenuity of the poor inhabitants of Indenbach, near Sonneberg. They bought their manufactures and urged them to produce more, teaching them from models which they brought from Berchtesgaden how to improve their goods and how to decorate and to paint them. The merchants gave the poor people money in advance for their manufactures, and when they returned they packed them up and exported them to all parts of the world.

### NUREMBERG STILL FLOURISHES.

This was the origin of the toy manufacture in the villages around Sonneberg. Nuremberg was then the great city for toys, and for centuries the people of Thuringia looked upon the Nuremberg merchants as their benefactors. The Nurembergers saved them the trouble of hawking, as their forefathers had to do, their productions about the country. Soon, however, native merchants sprang up, and acquired a sufficient degree of wealth to command the local trade. Soon the demand proved greater than the production, whereupon the neighboring villages no longer resisted the temptation of earning as much money as the Judenbachers by an industry for which they all proved to possess the necessary skill.

### THE TRADE INCREASES.

Thus it came to pass that at the end of the seventeenth century, Sonneberg, a very small place then of not more than seven hundred inhabitants, about four miles from Indenbach, became the center of the district of the manufacture of wooden articles and toys. Sonneberg rapidly increased in size and became the center for all the productions of the "highlands" of the duchy of Saxe-Meiningen. Indeed, this Thuringian Oberland was from the beginning of the sixteenth century considered throughout the continent as an Eldorado. There were gold mines in Steinheide,

gold washing at Grümpen, iron stones and iron furnaces, the materials for glass manufacture, and those, though of a later date, for the manufacture of china, all within ten or twelve miles from Sonneberg. The wealth above ground—the splendid woods and forests—were then not considered so highly as the wealth under the ground, "gold and iron!" But at the close of the sixteenth century the inhabitants found that their "gold and mineral wealth" was delusive. Wages had become too high for the digging and washing of the precious metal, and places formerly prosperous were left to poverty and neglect. No attention was paid during the mineral fever to the manufacture of wooden ware. No saving of wood was thought of, as there appeared plenty for centuries to come. Indeed, the Meiningen highlands, about five German square miles, was and still is a wonderful spot in the very center of Germany, created for industry of every description. There were wood, coal, slate, fireproof sandstone and clay, kaolin, chalkstones for marbles, tophus chalk, the brightest gold ocher, the famous whetstones and touchstones. No wonder, then, that Sonneberg should have been recognized in early times as the market for the manufacture and export of toys.

### DEVELOPING THE TOY INDUSTRY.

In 1595 the riches of the woods and forests around Sonneberg attracted two Bohemians, to which soon a "Schwabe" (Würtemberger) associated. Müller, Böhm, and Greiner set up glass huts in Lauscha, where they produced drinking glasses and bull's-eye window glasses. The descendants of these three families soon reached such a number that it was deemed necessary by the fathers to establish more glass huts in different parts of the country. These three family names are still prevalent in the glass and china manufacturing district around Sonneberg. About the middle of the eighteenth century it happened that owing to religious persecutions and troubles in the Salzburg districts, to which Berchtesgaden belonged at that time, a party of wood carvers, turners, and painters came to settle in the mountains near Sonneberg, chiefly in Indenbach, on the highroad running from South to North Germany. In skill they excelled all the native makers, and as they were a very good-natured people, the Thuringians profited a good deal in the manufacture and painting of toys, chip boxes, and chests of drawers. Those Berchtesgaden emigrants soon felt at home in the Thuringian mountains. The people had much the same manners and customs as themselves. Besides, the birds in the Thuringian woods sang the same songs as their favorites in the Salzburg forests. Other emigrants came from the Bavarian highlands, introducing the manufacture of marbles, which began in their country between Salzburg and Berchtesgaden (the Untersberg). They did not discover a marble like that on the Untersberg, but they found a hard chalk stone, in pieces of all sizes, in the fields west of Sonneberg, even more adapted for marbles than their hard marble stone of the Untersberg. On the Untersberg the rounding of the stones was done by means of waterfalls, to which the square stones are exposed for a certain time. Every tourist there may witness this method practiced up to the present day. Near Sonneberg there are no waterfalls of sufficient height, so another system of shaping marbles had to be found out. A millstone and a wooden block were used, both having inside semicircular rings corresponding together. Pieces of stone of about an inch square were put between these two grinding stones, brought into rotation by water power, and ground round. By such means fifteen to twenty-five thousand marbles are produced annually by every mill in the neighborhood of Sonneberg, about thirty being scattered about in the valleys. On the Untersberg, where the making of marbles is left to nature only, a comparatively small number of "allies" is produced. "Allies" is their mercantile name, while the Sonneberg marbles are known as stone marbles simply. The production of marbles greatly increased Sonneberg's fame. Whetstones were another important article of trade; and, in fact, no country has so rich and varied sorts and qualities.

### A WORLD FAME.

In the beginning of the eighteenth century Sonneberg's wooden toy industry was known in all parts of the world. Some Sonneberg merchants had settled in Denmark and in Holland, and were ship owners. One had his largest ship called Sonneberg. At the Frankfort fairs Sonneberg wares were a prominent feature and highly sought after. To attract the Sonnebergers with their goods to that fair presents of wine were offered by the magistrate to the merchants, who had less tolls to pay than other merchants. About the middle of the eighteenth century a great improvement in the toy manufacture was introduced by the application of paste to those toys which had hitherto been turned and coarsely carved. We may still see in the toyshops those old style wooden turned dolls, with oval faces and small sticks put in to represent the noses. Paste, made of flour and glue, was the material for improving the shape and form of toys, saving the expense of carving the wood. Moulds were made of sulphur, for instance, of dolls' faces, the paste was pressed in by hand, dried, glued on, and then painted over and varnished. These paste toy makers called themselves "Bossirer" and formed an "Innung," which was in high respect, for, indeed, it was astonishing how quickly these modelers applied arms and legs to the lump of wood, which was the body of the figure. The paste was rolled up in round pieces of the size of one's finger. The bend of the knee, the shaping of the foot or of the hand, was done in a moment, the head stuck on, and the whole placed on a horse's back, and one of the well known penny horsemen was ready for drying and over-painting. Such horsemen, five inches high, on a plank with four wheels, are produced, everything included, at nine cents per dozen, and are retailed in London at three cents each. Wooden dolls with paste faces, drummers on clapping boxes, different craftsmen on musical boxes, rope dancers, sentinels, etc., walking to and fro, were quite prominent toys up to the beginning of this century; but there were also large mechanical toys produced by some very ingenious makers, which were destined for the use of princes and princesses. For instance, "Tell Shooting the Apple from His Son's Head." This feat was literally performed by a man with a miniature crossbow, the figure of Tell being not higher than six inches. Then there were mechanical shows and dancing, and when octave organs were introduced (an invention of the Schwarzwald Dutch clock makers), such figures were added with great skill and exported to serve as wonderful sights in distant countries. "Paste," however, did not prove good for export. In the first place the mice were very fond of it, and could soon eat up a regiment of penny horsemen.

### THE ERA OF PAPIER MACHÉ.

The toy trade was consequently limited, and wooden toys only were fit for export. In 1810 a new era rose for the Sonneberg trade through the introduction of papier maché instead of paste. A Mr. Frederic Müller, of Sonneberg, was the introducer. He first made the moulds for this new material and manufactured dolls' heads. New makers sprang up, producing different toys in papier maché, animals and figures of every description. Papier maché is a mixture of mashed paper, flour, chalk, and glue, and the moulds are taken of the models in the following way: Suppose a doll's head mould is to be cast. The toy manufacturer makes the models and moulds mostly himself. He hands out his moulds to a "caster," who does nothing else but prepare the papier maché and press it with his fingers into the two half moulds. When the material is sufficiently dry both halves are joined together with glue and moist papier maché. The "casters" attain such facility in forming or casting that they can furnish the bodies of birds of natural size at ten cents a dozen, delivered to the makers. The latter put on the legs and beaks, and paint or cover them with flock or cloth. Figures of legs or arms, if not attached to the body, also require a separate mould, and the castings of each must be glued together when sufficiently dry and hard. Most toys require three to six skilled workmen each, one independent of the other. For instance, a cheap doll requires a combination of the productions of five different workmen—the papier maché bodies and heads; the wood turners, legs and arms; the bellows makers, leather bellows to produce the voice; the glass makers, glass eyes; the headdress makers, wigs. Without such a division of work it would be impossible to get up dolls at so cheap a price.

Since the introduction of papier maché in Sonneberg the toy trade has increased from year to year. It is not only the cheapness which distinguishes these toys, but their correct shape and natural forms. The value of a toy, correct in form, is more and more appreciated in civilized countries. It is the "alphabet of art," in a child's hand. Nothing can do more harm to a child's eye and feeling than a false plastic representation of a figure or animal in the shape of a toy. From this point of view the papier maché toys of Sonneberg have a great merit, being the cheapest accessible to the poorest classes.

There are 10,000 different toys manufactured at Sonneberg. A show room there, be it ever so large, cannot hold all. Changes in form and fashion are constantly taking place. There is a continual demand for something new, and the maker who would be prosperous has to keep pace with the demand and the times.

The consequence is a constant rivalry among the makers for improving their manufactures. Schools of drawing and modeling are established not only in Sonneberg, but in most of the large villages round about. The learning of drawing is obligatory for both the boys and girls of the district, and it is very interesting to see exhibitions of the students at the annual proof days.

## GENERAL ARTHUR JULES MORIN.

GENERAL ARTHUR JULES MORIN, whose death has been but recently announced in the French papers, was born in 1795, and had since the year 1843 been a prominent member of the Academie des Sciences. Educated for the army, he was at an early period of his life somewhat undecided as to his future career; and, for a time, devoted himself to the in-

dustry of forges. But he soon assumed again his epaulettes of artillery officer, which permitted him to happily exercise his scientific qualifications at the School of Metz, where he became assistant to Poncelet. He expended an immense amount of mental labor in his researches on the numerical coefficients relative to friction, the traction of wagons, the shock of projectiles, the useful effect of the principal hydraulic receivers, etc. His dynamometer and his *Aide-memoire* have contributed in a great measure to the development of the mechanic arts in France. The *Aide-memoire*, so popular in France, has been translated into five different languages because of its great value in indicating for every problem its truly practical solution. A few words will suffice to show General Morin's method of work, which was always based on observation. It became a question to know whether the traction of vehicles varies according to a definite law. He invented and constructed the necessary apparatus for measurements, and ascertained that the traction is proportional to the diameter of the wheels. Now others had asserted that it was proportional to its square root. Morin, therefore, in order to resolve the problem without any dispute, tried every type of wheel in use, and was finally enabled to end the discussion by a series of figures which had the honor of being crowned by the Academie. The first labors of Morin had obtained for him the position of successor to Poncelet at the School of Metz; and in 1839 he was greatly astonished to learn that, without having ever been consulted, he had only to accept the chair of applied mechanics, which had been created especially for him at the Conservatoire des Arts et Metiers. In 1843 he was elected a member of the Academie des Sciences, to fill the vacancy occasioned by the death of Coriolis. Called, in 1848, to the Directorship of the Conservatoire des Arts et Metiers, Morin found in this position opportunities of rendering new services to science and industry, by occupying himself with questions so varied and so numerous that it would be impossible to enumerate them in this place. Under his administration the value of the collections of the Conservatoire arose from one million to three million francs, and by him they were put in most perfect order. It was he also who instituted four additional public courses, comprising civil constructions, economic manufactures, weaving and spinning, dyeing, ceramics, and the manufacture of glassware.

## THE ALBERT MEDAL.

THE Council of the Society of Arts, London, will proceed to consider the award of the Albert Medal for 1880, in May next. This medal was struck to reward "distinguished merit in promoting arts, manufactures, or commerce," and has been awarded as follows:

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great service to arts, manufactures, and commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilized world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of arts, manufactures, and commerce, the proofs of which are afforded by his judicious patronage of art, his enlightened commercial policy, and especially by the abolition of passports in favor of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted arts, manufactures, and commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labors in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of arts, manufactures, and commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honor, etc., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by arts, manufactures, and commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to arts, manufactures, and commerce, by the realization of the Suez Canal."

In 1871, to Mr. (now Sir) Henry Cole, C.B., for his important services in promoting arts, manufactures, and commerce, especially in aiding the establishment and development of international exhibitions, the development of science and art, and the South Kensington Museum."

In 1872, to Mr. (now Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to arts, manufactures, and commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to W. C. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economization of fuel in its various applications to the manufactures and the arts."

In 1875, to M. Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential service in promoting arts, manufactures, and commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., the Astronomer Royal, "for eminent services rendered to commerce by his researches in nautical astronomy, and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the industrial arts."

In 1878, to Sir Wm. G. Armstrong, C.B., F.R.S., D.C.L., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious manual labor."

In 1879, to Sir William Thomson, F.R.S., LL.D., D.C.L., "on account of the signal services rendered to arts, manufactures, and commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

## INDIAN FREIGHTING AND MECHANICAL PURSUITS.

IN his last annual report the Secretary of the Interior says: "In my last annual report I mentioned that late in the autumn of 1878 the conveyance of supplies from the Missouri River to the Sioux agencies recently established in Southern Dakota was intrusted to the Indians themselves. The department furnished wagons and harness and the Indians their ponies as draught animals. A shout of derision all along the Upper Missouri greeted the experiment. A disastrous failure was confidently predicted by those interested in the freighting business and many others. But not only did the Sioux succeed in keeping their agencies supplied during an uncommonly hard winter, taking their wagons over desolate plains without roads, a distance of 90 and 198 miles respectively from the river, but they have proved the most efficient, honest, and reliable freighters the Indian service ever had. Not a pound of freight was lost; although the Indian freighters, occasionally delayed by accidents or extraordinary difficulties on their weary way, were sometimes without provisions, not a cracker box nor a pork barrel was broken open. In the course of the year Indian freighting has been introduced at a large majority of the agencies this side of the Rocky Mountains which are at a distance from railroad depots and steamboat landings, and uniformly with the same success. There are now 1,356 wagons run by Indian teamsters in that occupation, and the overland freighting is done better, more faithfully, and far more economically by them than it ever was done for this department by white contractors. But for

the difficulties connected with the giving of bonds we should now be in a condition to have the Indians make bids for freighting contracts for other branches of the public service. The introduction or freighting among them has not only been a great success in itself, but has given a powerful impulse to the desire to work and to earn money among all the Indian tribes that have been so employed. It will be introduced at all the agencies where it is practicable.

"The employment of Indians in the mills and workshops on the agencies has been tried with equal success. In some of our grist and saw mills Indians act as engineers. In the blacksmith shops, saddler shops, and carpenter shops at the agencies 185 young Indians are instructed as apprentices, and their number is being constantly increased. Some of the shops are successfully controlled by Indians as foremen, and the employment of Indians as laborers in a variety of other ways has been generally introduced. On Indian reservations where suitable clay is at hand the establishment of brick yards to be worked by Indians is contemplated and will be begun next spring. On the Sioux reservations in Southern Dakota Indians are engaged in putting up telegraph lines. The building of houses for Indians by white contractors has been abandoned, and Indians are now constructing their houses themselves, window sash, shingles, and planks, the latter sawed in the mills on the reserves, being furnished to them. The old Indian prejudice that it is improper for men to do anything else than hunt and fight, and that squaws only should work, is being rapidly and very generally overcome. The progress made in this direction is indeed unequal on different reservations, but progress has been made almost everywhere, and at many agencies it has been very great and surprisingly rapid."

## PHYSICAL SOCIETY, LONDON.

Meeting, March 14, 1880—Dr Huggins in the chair—Mr. W. Chandler Roberts drew attention to an explanation which had recently been suggested by Dr. Van Riemsdijk, of Utrecht, to account for the "flashing" which attends the solidification of cupelled buttons of gold and silver. He showed experimentally that, at the point of solidification, the metals emit a flash of greenish light, which Dr. Riemsdijk thinks is probably due to the globules being really in what is known as the superfused or surfused state; that is, they fall some degrees below their point of solidification without setting, and the change from the liquid state is accompanied by the liberation of the latent heat of fusion, which again heats the globule and renders it incandescent. In an attempt to obtain indications as to the state of certain fused metals by the aid of the induction balance, Mr. Roberts was able to show that the resistance of silver in the molten state is far greater than when the metal is solid; and, on the other hand, he had confirmed De la Rue's statement that the resistance of molten bismuth is less than that of the solid metal; and he also obtained evidence that bismuth in cooling may be made to pass through a superfused state similar to that which occurs in the buttons of gold.

Mr. Lockyer thought the greenish tint of the light might be due to a solid film on the globule.

The Secretary then read a paper by Prof. W. F. Barrett, announcing that he had found a current of electricity to be generated by the rotation of the prepared chalk cylinder in the receiver of the Edison telephone. When the platinum stylus which rubs on the cylinder is connected through a galvanometer to the brass axle on which the cylinder is mounted a current is observed whose E. M. F. is over one-third volt. This current falls off as the rotation continues, owing, Prof. Barrett surmises, to the electrification of the surface of the chalk. Prof. Barrett attributes the current to friction solely, and seeks to account for the receiving action of Edison's telephone by the frictional current being modified by the transmitted currents, and not by the electrolytic action to which it is usually ascribed. These experiments originated with a suggestion of Prof. Sylvanus Thompson that the Edison receiver might act as a transmitter. Prof. Barrett had at length succeeded in making it act in this capacity by means of the frictional current.

Mr. Shelford Bidwell exhibited some experiments bearing on Prof. Barrett's observations, which tended to show that the source of the current in the Edison receiver was due to the fact that the voltaic element is formed by the platinum rubbing point on the brass axle and the prepared chalk. This chalk is usually impregnated with phosphate of soda or, as in the author's experiments, with caustic potash and acetate of mercury. The cylinder seems to be dry, but is probably moist; wetting it greatly increases the current. There is a very feeble current when no motion of the cylinder takes place, but rotation of the cylinder greatly increases it. Platinum is electro-negative to brass, and hence the positive current flows from the platinum to the brass through the galvanometer. This was demonstrated by substituting zinc for platinum, when the current was reversed and flowed from the brass to the zinc, owing to the fact that brass is electro-negative to zinc. Mr. Bidwell showed, by means of a simple pile of copper and tin foil, separated by a moist cloth or paper, that the motion of the tin across the paper increased the current of the cell. In the case of a cell made of *two* tin plates separated by moist paper, a current was set up by moving one plate over the other. The plate which moved relatively to the paper was always electro-negative to the other. Mr. Bidwell also showed by a simple experiment that the action of Edison's receiver was electrolytic. He caused the mere passage of a current to lessen the friction of a metal strap on a drum covered with moist paper, and thereby release the drum by the evolution of hydrogen.

Prof. Ayrton pointed out that the rubbing action in these experiments assisted the current by bringing up fresh electrolytic matter, a fact which had been taken advantage of in the construction of several batteries.

Prof. Adams remarked that this explanation did not seem to explain how the current was *reversed* in the cell composed of *two* tin foil plates.

Prof. Guthrie then demonstrated by experiment a curious anomaly in frictional electricity. When flannel is rubbed with ebonite, the flannel is + electrified; when ebonite is rubbed with glass, the ebonite is + electrified, and we should therefore expect that when flannel is rubbed with glass, the flannel would be still more + electrified; but, instead of that, it is really feebly negative. Perhaps the fact that the heat of friction entered into one substance more than the other affected such results.

The Secretary then read a note from Mr. Ridout, stating that he had succeeded in Dr. Guthrie's funnel experiment, mentioned at last meeting, and by means of a stream of water flowing out of a glass funnel had attracted a glass cone toward the mouth of the funnel. The angle of the cone was greater than the angle of the funnel.

## FLEUSS' DIVING HELMET.

A STEP in advance in diving equipments has recently been made by Mr. Fleuss, who has ingeniously contrived to dispense with the use of pumps and air pipes, although the wearer of the helmet he has devised may remain under water several hours. The means by which he is enabled to effect this stay are all contained within the dress, and there is nothing whatever communicating with the surface except a single cord. The principle consists in purifying the air exhaled by the diver, and revivifying it with oxygen, the same air being breathed over and over again, *minus* carbonic acid and *plus* fresh oxygen at each inspiration. To this end a close fitting leather shield, provided with inlet and outlet valves, is held in position over the mouth and nostrils of the diver by elastic fastenings. The exhaled breath passes out through a flexible tube communicating with a purifier which is carried in front of the diver and under the dress. This purifier is a flat metallic chamber, having a perforated inner false bottom, and being divided vertically from the top to the false bottom into two compartments. Each of these compartments is fitted with India-rubber sponge, saturated with a solution of caustic alkali. The exhalations enter at the top of one compartment, pass down it through the false bottom and up the second compartment. From thence they pass by a tube to a second purifier, carried at the back of the diver. This purifier is similarly constructed and charged to the front one, but is of somewhat larger dimensions. The exhalations enter at the top and pass down the first and up the second compartment, by which time the air has been deprived of all its deleterious absorptions. It then enters the interior of the helmet and surrounds the diver's head, where it is revivified by the addition of oxygen. This gas is contained in the helmet itself, which is made double for the purpose, and consists of an inner and outer casing, so that it is somewhat larger externally than the ordinary diver's helmet. The oxygen is stored in the helmet under a pressure of about 200 lb. per square inch, and its admission into the air space is regulated by the diver, by means of a small valve actuated from outside the helmet. The storage space in the helmet is of sufficient capacity to contain four cubic feet of oxygen, which supply will last for four hours, the longest time a diver would be required to remain under water in ordinary practice. In like manner, the purifiers contain a sufficient quantity of the caustic alkali to serve for a similar period. We were present a few days since at a demonstration with this invention at Messrs. Siebe, Gorman & Co.'s Neptune Works, Mason Street, Westminster Bridge Road, those gentlemen being the sole manufacturers and agents for the helmet and gear. Mr. Fleuss descended into fourteen feet of water, and remained there for about half an hour without any communication with the outer atmosphere, and coming up as fresh as he went down. He has remained under water for one hour and ten minutes, only then being obliged to come to the surface on account of the cold. He informs us that he has worn the dress for 2½ hours in a room with perfectly satisfactory results. The invention is exceedingly ingenious as well as practical, and will no doubt prove very useful in the numerous cases which are of daily occurrence, especially in connection with docks and other similar works, where the assistance of a diver is required occasionally, but quickly, and under circumstances in which to be unhampered by air pumps, and their necessary gear and attendants, would be a great gain.

## THE TRANSMISSION OF HEAT.

IN instituting trials to determine the speed of transmission of heat in an iron rod, Monsieur C. Decharme noted the differences of temperature from minute to minute of four thermometers placed at intervals of 20 centimeters from each other, and from both ends of a rod of homogeneous iron, 1 meter long and 21 millimeters thick, resting on two cork disks, with one end subjected to the heat of a gas flame. The thermometers, which registered an alteration of temperatures of 0·1 Centigrade accurately, were placed in holes 14 millimeters deep and 6 millimeters wide, packed with quicksilver or powdered iron and sheltered by a screen from the influence of radiated heat.

The heat when applied to the end of the rod reached:

| | Minute. |
|---|---|
| Thermometer No. I. 20 centimeters from the flame, in | 1·00 |
| " " II. 40 " " " | 4·50 |
| " " III. 60 " " " | 10·00 |
| " " IV. 80 " " " | 16·00 |

Before the application of the heat all four thermometers indicated 7·30 Centigrade, that being also the temperature of the room taken at a level of 20 centimeters below the bar, 3 meters away from it. The above times, which differ only slightly from 1, 4, 9, and 16 minutes, show that the progressive speed is approximately the inverse ratio to the squares of the distances of the thermometers from the source of heat. The times at which the four thermometers became stationary were respectively 150, 190, 220, and 250 minutes, nevertheless the heating was continued for 300 minutes, when they registered 58·8°, 42·7°, 23·0°, and 15·5°, or in excess of the surrounding air, which had meanwhile risen to 9·5°, respectively 89·3°, 33·2°, 13·5°, and 5·7°. As soon as the flame was extinguished the thermometer began to recede, and in 200 minutes had fallen to the temperature of the room. Monsieur Decharme constructed first a system of curves to show the more regular and gradual process of cooling, and then, with the help of numerical data, a system of synchronous curves of all four thermometers showing the thermal waves from 1 to 10 minutes as they transmitted themselves through the rod, from which the temperature of any point of it, after a certain space of time, either during the periods of heating or of cooling, or even while in a stationary condition, can be ascertained. In the above trials a sufficient time was allowed to elapse each time after extinguishing the flame until each thermometer became stationary, and it was found that the heat continued at first steadily to spread itself through the rod, as if it had attained a certain velocity, which it only gradually lost, each thermometer attaining its maximum so much later in proportion as it was farther from the source of heat, whereas the temperature of the thermometer nearest to it began first to recede, and was followed at intervals by that of the others in the successive order of their distances from the first. In other trials the rod was heated under similar conditions for 5, 10, 15, and 20 minutes, or during periods of T, 2T, 3T, 4T, and the following relation was found between these periods, and the spaces of time $t$, $t'$, $t''$, $t'''$, which elapsed between the moment of removing the source of heat and that of the thermometers attaining their maximum temperature: $T+t=2T+t'=3T+t''=C$. That is, the sum of both the corresponding values of time is a constant quantity.

## VARIATION OF THE COMPASS IN THE UNITED STATES.

PROF. J. E. HILGARD has for several years past been making researches on the subject of the variation of the compass in different parts of the United States, the expense of the same being defrayed by the income from the Bache fund. Observations of the magnetic declination have thus far been made at about 200 stations, distributed over a large area of the interior country, at about 150 of which stations the dip and horizontal intensity were also observed. These observations will be published in detail under the auspices of the National Academy of Sciences.

Since the data obtained by the Coast Survey form a very large part of the material used, it has been thought best to give the general results to the country as early as possible. This has been done in the form of a map showing the variation of the compass (the element of the most practical utility) by means of so-called isogonic lines, and which appears in the recently published Coast Survey Report for 1876. Incessant demands have been made upon the office of the Coast and Geodetic Survey for information relative to the variation of the compass in different sections of the country; and the similar map given in the report for 1865 having been highly appreciated, the one under consideration cannot fail to prove still more valuable and useful, since it is not only brought up to a more recent date, but is based upon a very much greater number of observations in the interior. The approximate annual change of the declination or variation of the compass for the epoch 1880 in various parts of the country, as given by Prof. Hilgard, is shown in the table annexed. The observed amount of change is by no means the same, even in places not far remote from each other, as New York and Philadelphia. In grouping together a table of the present rate of change much allowance must therefore be made for possible local peculiarities that have not been ascertained. For the interior States the information is very scanty, or altogether wanting.

The annual change is expressed in minutes of arc, a + sign indicating increase of westerly or decrease of easterly declination. The negative sign indicates an easterly declination:

| Locality. | Annual change. |
|---|---|
| Maine, coast of | +2′ |
| Maine, interior | +3 |
| New Hampshire | +3½ |
| Vermont | +5½ |
| Massachusetts, eastern part | +2½ |
| Massachusetts, western part | +3 to 4 |
| Rhode Island and Connecticut | +3½ |
| New York, Long Island | +2½ |
| New York, northern and western part | +4½ |
| New Jersey | +3 |
| Pennsylvania | +3½ |
| Ohio | +2½ |
| Tennessee, eastern part | +2½ |
| Tennessee, western part | +2 |
| Missouri | +2 |
| Delaware, Maryland, and Virginia | +3 |
| West Virginia | +3½ |
| North Carolina, South Carolina, Georgia | +3½ |
| Florida, northern part | +3½ |
| Florida, southern part | +3½ |
| Alabama, Mississippi, Gulf coast of | +3½ |
| Louisiana, eastern part | +3 |
| Louisiana, western coast | +2 |
| Texas, coast of | +2 |
| Texas, southwestern part | 0 |
| Colorado | +2½ |
| Utah | + ½ |
| New Mexico and Arizona | 0 |
| California, coast of | −1½ |
| Oregon, coast of | −2 to 2½ |
| Washington Territory, coast of | −2½ to 3 |

## THE IRON AND COAL MINES OF VIRGINIA.

PROF. THOMAS EGLESTON recently gave an interesting lecture, relating to the iron and coal resources of Virginia, before the New York Academy of Sciences. Prof. Egleston first referred to a map of Virginia and West Virginia, showing the topography of that remarkable mineral district. Virginia, he said, was essentially an iron-producing district, and West Virginia possessed unlimited coal resources. He should confine himself principally to the iron district. This district was circumscribed by the Alleghanies on the east, and the Blue Ridge mountains on the west.

The Blue Ridge died out in North Carolina, and the Alleghanies died out before they reached North Carolina. This gave a series of ores, remarkable in themselves, beginning on the east near the Potsdam district, and running through the entire breadth of the country. These ores, though new, were as distinct and as certain as any he had ever known. There was no difficulty in making out, even from the top of a stage-coach, the geological formation of the country. Specular ores were found there that might have come from Lake Superior, so rich were they in minerals.

The mountains in the central district were ranged in *echelon* for 100 miles, from Staunton to Clifton. These mountains outcropped three or four folds, and occasionally twelve times. Usually they did not outcrop so often, and gave a continuous bed of iron. These iron fields had not been very largely developed, from the fact that transportation was expensive and difficult, and fuel scarce. Even at the location of iron deposits entirely free from titanium, so dependent were they upon charcoal for smelting purposes, and upon the uncertain and expensive methods of transportation, that they had not been developed and did not produce any adequate supply for the market.

The time must come, however, when these mines would be opened, and then it would be found that there was existing in them a series of ores disclosing an iron district not second to any in the United States. Prof. Egleston said he had analyzed over eighty specimens of different classes of ores which had come from these districts between Staunton and the James River. He had found in the outcropping ores, in the greasy limnites, from one to one and two-tenths per cent. of phosphorus. In the other ores the percentage was generally lower than five-tenths, and sometimes they went down as low as three-tenths and one-tenth of one per cent. of limnites. The situation of the iron beds was favorable to mining.

During the progress of the late civil war, the Confederates had attempted to manufacture iron, but, for some reason not known to the speaker, they had failed in producing any substantial results. By unfortunate selections they had obtained ores containing as high as two per cent. of phosphorus, which would not make good iron. When railroads were constructed, which would not be long hence, there would be a revolution in the manufacture of Virginia iron.

Having described somewhat in detail the iron resources of Virginia the Professor turned his attention to the great coal beds of the Kanawha valley, in West Virginia. This valley, he said, did not seem to be a valley formed by erosion, but to be owing to a geological accident. The Kanawha river took the course of that accident, and on the line of the river there was a series of accidents occurring in the coal formation which rendered it very unfortunate for the present and future owners of the district.

It was inaccessible, and could not be mined without much expense. There were workable beds there forty inches in thickness. In the middle coal fields he had seen fully twelve feet of good clean coal. When the mines were exhausted along the banks of the river the works would have to be removed, at much expense, over the hills into the interior. Notwithstanding so much had been said and written about the Kanawha coal fields, very little was known concerning them excepting along the line of the Chesapeake and Ohio Railroad

In concluding, Prof. Egleston said there was more iron in Virginia than in Pennsylvania. It had not been worked, but lay there as wealth for future generations. If the prosperity in the iron trade continued, an industrial survey would have to be made of this country, either by private parties or by the State Governments themselves. If an industrial survey was once made in Virginia, within a short time after it was published capital would flow into that State and cause a prosperity there such as had never been known previously. He had said nothing of the other resources of Virginia, as copper, gold, and a small amount of silver. Virginia was lacking in fuel, capital, and transportation, which rendered this State almost as virgin as that of Texas. Prof. Egleston received the thanks of the society for his lecture.

## AN IMPROVED METHOD OF ALKALINE DEVELOPMENT FOR GELATINE PLATES.*

NOTWITHSTANDING all that has been written from time to time on the subject of alkaline development, I make no apology for again introducing the subject to your notice this evening in connection with gelatine plates—the latest and most important improvement in photography. Development by alkaline pyrogallic has always been a favorite method of working, owing to the great latitude in exposure allowed by its use, and to the fact that it affords almost complete control over the density and detail of the finished negative. There are, however, certain disadvantages connected with this mode of developing as usually practiced, owing chiefly to the rapid deterioration of the developing solutions when mixed ready for use. It is well known that an acid solution of pyrogallic will keep and retain its properties for a very long time; but when an alkali is used in place of the acid in a few minutes the mixture becomes decomposed and utterly useless. Even a solution of plain pyrogallic in water will only keep a very short time, and begins to deteriorate from the moment it is mixed. For these reasons it has, I believe, now become the general custom to make the developing solution by adding a small quantity of dry pyrogallic acid to the quantity of water required for the development of each separate plate, which is better than the old plan of using dropping bottles or tubes; but there are grave objections besides the inconvenience of measuring small quantities of dry pyrogallic. In the first place, small particles of this light, feathery substance are very apt to blow about the dark room, and would in time doubtless accumulate in odd corners and cause trouble in various ways. Secondly, and more important, it is practically impossible to guess the exact quantity required for each plate so as to keep the developer at a uniform standard strength; consequently as the density of the negative depends to a great extent upon the quantity of pyrogallic in proportion to the other ingredients, it becomes exceedingly difficult to obtain negatives of anything like uniform printing density.

To obviate this difficulty it has been proposed—first, I think, by Mr. Swan—to make separate standard solutions of ammonia and bromide and pyrogallic in water of the strength required for use, and to mix equal parts of these two solutions just before developing the plate. This plan I think far preferable to the others I have mentioned, if we can only keep the solutions always in their best condition and always ready for use. Both these conditions are fulfilled by the methods I have now to describe, and which I have used for the last six months in daily practice in the studio.

Make two stock solutions, and label them No. 1 and No. 2.

No. 1.

| | |
|---|---|
| Pyrogallic acid ... ..... | 1 ounce. |
| Glycerine ... ..... | 1 " |
| Methylated alcohol..... | 6 ounces. |

Mix the glycerine and spirit and add to the pyro.

No. 2.

| | |
|---|---|
| Bromide of potassium (or ammonium)... | 60 grains. |
| Liquor ammonia, 0·880..... ..... | 1 ounce. |
| Glycerine ..... .... | 1 " |
| Water..... | 6 ounces. |

The above stock solutions will keep any length of time

To make the developer, add one part of No. 1 to fifteen parts of water, and label this bottle D (developer). In another bottle mix one ounce of No. 2 with fifteen ounces of water, and label it A (accelerator).

It will be found convenient, to avoid mistakes in the imperfect light of the dark room, to have these two bottles of different shapes. Either of the above solutions will keep two or three days. When required for use pour into a clean glass measure equal parts of D and A, adding the A last just before using. Place the dry, exposed plate face up in a shallow dish or tray, and pour the mixture steadily over the plate, avoiding air bubbles; should any adhere to the surface of the plate, at once remove them with the finger or a camel's hair brush kept for the purpose. Rock the dish gently, taking care to keep the plate well covered with the solution. In a few seconds the image will appear, and, if the exposure has been well timed, all the details will be out and the development complete in about one minute, when the negative should be well washed under the tap and placed at once in the fixing bath.

Do not hurry the development, but allow the plate to remain in the solution after all the details are visible until the required density is obtained. With this developer used in the above proportions there is no danger of fog, except from the action of light.

If on the application of the mixed developer the image flashes out and the details in the shadows appear too quickly, it will indicate that the plate has been over-exposed, therefore at once throw off the mixed developer, and, without stopping to wash the plate, flood it with D alone, when the development will be checked, and will proceed more slowly, while the image gains in density; if too slowly, or the negative appears to be getting too intense, add a very little of A. There will, however, usually be sufficient of the latter left on the plate to complete the development with the simple addition of a sufficient quantity of solution D. A very little experience will enable the operator to produce a good printing negative from a plate which, if developed with the full proportion of A, would have been utterly useless from over exposure. (In very warm, bright weather it will, perhaps, be found an advantage to use rather more D than A in the mixed developer, giving just sufficient exposure to avoid hardness in the negative.) Under-exposure can be corrected to a great extent by increasing the proportions of A in the mixed developer, but the addition should be made at once before the development has proceeded too far, or the effect will be to increase the density and cause too much contrast in the negative.

The proportions of the mixed developer can be varied at will by the operator according to the character of the results he wishes to produce. The proportions given above are suited to my own plates and some others I have tried, but probably would not suit all kinds of plates without some modification of the stock solution, such as the addition of a greater quantity of the restraining bromide in the No. 2 solution.

These concentrated stock solutions will be found very convenient to use, and a great saving of time in weighing and measuring small quantities.

With regard to the keeping qualities of the No. 1 pyro solution I have found no difficulty whatever; the glycerine seems to act as a perfect preservative. The bottle marked No. 1, which I now hand round for your inspection, was mixed last August, more than six months ago; the solution seems to have undergone no change, and it is now about the same color as the day it was mixed. That this is owing to the glycerine and not to the alcohol is proved by the other bottle marked No. 2, which contains no alcohol, but the same proportions of pyro and glycerine mixed with water and kept six months; this, you will observe, has become slightly discolored, but is still in good condition.

I am satisfied of the value of glycerine (or glycerine and spirit) as a solvent and preservative of pyrogallic acid, and I have also every reason to believe that the presence of a small portion of glycerine in the developer is of great benefit. It seems to act as a restrainer, and entirely prevents fog, even with a very small proportion of free bromide; in fact, with some plates I have found no difficulty in dispensing with the bromide altogether. I also find when using this developer that I have far greater control over the density of the finished negative, as the developer never fogs. It is only necessary to allow it to remain on the plate until the required density is obtained, thus obviating the necessity for after-intensification. Since adopting this method I have had no occasion to intensify any of my negatives.

I have brought with me two or three negatives for your inspection. They have all received different exposures, two on each plate; and, although developed with the glycerine developer, in the usual way without special care, you will find that in every instance the densest negative is that which has received the longest exposure. This effect may possibly be, to some extent, peculiar to my own plates, as I have not made comparative trials with plates of other makers; in any case I am glad to avoid the trouble and risk of intensification, for which I no longer find any necessity.

I have also brought a small bottle of the dilute pyrogallic solution which has been mixed two days; it is still in good working order, so that it can always be used to the last drop, and need not be wasted.

In conclusion, I trust that the modification I have described will be as successful in the hands of others as it has proved in mine.

B. J. EDWARDS.

* A communication to the South London Photographic Society.

## THE CORROSION OF IRON.

By Mr. WILLIAM FOSTER, M.A. (Cantab.), F.C.S., etc., Professor of Chemistry at the Middlesex Hospital.

SIR HUMPHRY DAVY first suggested the application of the principle of preserving metals at the expense of zinc, by coupling the two together, to the protection of sheathing of wooden ships. Sheets of zinc were to be applied to the surface of the copper, so that the surfaces of the two metals should be not only physically but electrically connected. When such an arrangement is immersed in an exciting liquid like sea water, the zinc is the negative element in the system and undergoes chemical change. Any chemical action which copper would undergo when immersed alone is in this way avoided, and transferred to the zinc. In my second article the leading features of this class of phenomena have been noticed. The application of the principle has been extended to the preservation of wrought and cast iron. Davy himself suggested that zinc or *tin* might be used for preserving iron. In suggesting *tin* for this purpose he fell into an error—an error which he, no doubt, was soon informed of by his contemporaries. When tin and iron are coupled together in a saline solution, the iron is negative to the tin and undergoes chemical change. Tin is, therefore, not a preservative of iron as suggested by Davy; on the contrary, it is itself preserved at the expense of the iron. When zinc and wrought-iron plates free from rust are placed face to face, and the whole immersed in fresh water freely exposed to the air, the iron plates are preserved from oxidation until a large amount of the oxide of zinc has collected at the points of contact of the metals. When this condition of things is reached, the iron ceases to be preserved—it undergoes oxidation. In saline solutions similar results follow, the chief difference in the two cases being that in saline solutions the oxide of zinc collects more slowly, probably in consequence of the solvent action exercised by the saline matter on the oxide of zinc. At length, however, the oxide of zinc is deposited on the surface of the iron, and the preservative action of the zinc then comes to an end. In order to obtain good results by this method of proceeding, the mass and area of the zinc must be comparable with those of the iron which it is intended to preserve. To maintain this condition of things in ordinary cases is inconvenient, and therefore the good results at first anticipated have not been realized in consequence of the difficulty of fulfilling the requisite conditions. Further, where the preservation of the iron is more a matter of economy than of absolute necessity, it is questionable whether great advantages could be obtained by the use of zinc protectors even in the most favorable cases. The principle could not be well applied to the preservation of iron gasholders; and in many similar instances the remedy would be as bad as or worse than the disease.

Pepys proposed the use of zinc plates for the preservation of polished iron and steel exposed to atmospheric air. There are, however, the same limitations in this case as in those already noticed. The corrosion of the iron is very considerably *retarded*, but not altogether prevented; and when the iron does begin to corrode, the zinc then completely fails to exercise a beneficial action.

This leads to the consideration of iron the surface of which is completely covered with a perfectly adherent layer of metallic zinc. One generally speaks of such as "galvanized" iron. Though it is possible to coat iron with zinc by means of a weak electric current (electro-plating), the so-called galvanized iron is obtained differently. It is prepared by taking plates or sheets of wrought iron and entirely cleansing their surfaces from every trace of rust. They are then thoroughly dried, and completely immersed in a bath of molten zinc. The zinc and particles of iron on the surface of the plate chemically combine to form an alloy, and on removing the plate from the bath the greater portion of the zinc so removed remains adherent to the plate in consequence of its being alloyed on the iron surface. It is found that the zinc surface adheres more firmly if the iron plate be immersed in a bath of molten tin (that is, converted into tinned iron) before immersion in the zinc bath. From what has been said respecting the electrical relations of tin and iron in exciting liquids, it follows that, should such galvanized iron be abraded or corroded so as to expose the two metals, tin and iron, the iron would then be subjected to undue corroding influences.

"Galvanized" iron, therefore, is iron covered with a uniform layer of metallic zinc, the two metals being alloyed together at their surfaces of contact. So long as the underlying iron is not exposed at any point, we may regard the whole as a mass of solid zinc. Zinc is a metal particularly well adapted for resisting ordinary corroding influences, such as atmospheric air and moisture. A bright surface of the metal, it is true, soon tarnishes when exposed to these influences, but the layer of suboxide thus formed preserves the metal from further corrosion. Alkaline salts, such as common salt (NaCl), sensibly dissolve such oxide; and caustic alkalies, including ammonia, dissolve it with the greatest facility. Zinc is a metal ill adapted for cases where it is likely to be exposed to acid vapors, such as arise from the combustion of sulphur or sulphur compounds.

Assuming that galvanized iron is used in the construction of gasholders, what will be their probable duration in a hot climate? Air and moisture would have but little action on the zinc, and therefore there would be little to fear in this direction. It is rather to the presence of ammonia in the gas and brackish water in the tank that we must look for agencies tending to corrosion. Since the coating of suboxide on the surface of the metallic zinc is the medium which preserves the metal from rapid change, it follows that ammonia, which is a ready solvent of the oxide, must be prejudicial to the duration of the holder.

It is well known to chemists that not only do the caustic alkalies, including ammonia, readily dissolve oxide of zinc, but that potash and soda also dissolve *metallic* zinc with the evolution of hydrogen gas. The action is augmented by increase of temperature. It is, therefore, very essential to know how metallic zinc would behave in a weak solution of ammonia. I have taken granulated commercial zinc and thoroughly drenched the fragments with a strong solution of ammonia, so as to dissolve the oxide on the surfaces of the pieces. After rinsing with distilled water several times, a very weak solution of ammonia was then added, so as to thoroughly cover the zinc, and the whole was left loosely exposed for a couple of days. The ammonia solution was then removed and examined for dissolved zinc. The pieces were again rinsed with distilled water, weak ammonia solution added, and the whole allowed to stand as before. The process was repeated on the same pieces several times in this way, the ammonia solution being always found to contain very appreciable amounts of zinc.

These results may be primarily due to the oxidation of the zinc in consequence of access of atmospheric air, and not owing to solution of the zinc direct, as in the case of potash and zinc. But the distinction is of no practical moment in the present instance, because we have seen that there are always small quantities of oxygen in coal gas; and, therefore, if ammonia is allowed to be present in the gas supply in quantities above the merest traces, there will then be in the interior of the gasholder all the conditions which were present in the experiments I have made. It is obvious, therefore, that the galvanized iron would be very seriously affected in a hot climate, if the gas supply contained sensible quantities of ammonia. The influence of brackish water on the zinc would be to dissolve the protecting surface of oxide, and in that way expose the metal to fresh oxidation. There would also be the general electrical action set up between the galvanized iron holder and its iron pillars, unless the two were specially insulated, and it would be difficult to effect perfect insulation, in consequence of the continual change of the points of contact of the two metals. But the use of brackish water is not generally imposed on the gas engineer, and as the ammonia can be entirely removed from the gas in an economical manner, even in a hot climate, there is no reason why these two circumstances should prevent the employment of galvanized iron in special cases, seeing that it promises well. I imagine that the drawbacks to its use are rather of a mechanical than a chemical nature. The holder would necessarily require to be constructed from sheets of the metal, and the rivets employed would be of iron. Therefore, unless the heads of the rivets presented an unbroken surface of zinc (that is, they must be galvanized), there would be an undue tendency to corrosion on the part of the zinc. Such a gasholder admits of being protected by varnishes and paints, as in ordinary cases; and it would, no doubt, be found advisable to pursue this course.

I now come to a consideration of Professor Barff's process for preserving iron. It consists in heating the metal in an oven (muffle), through which a stream of superheated steam is made to pass during the operation. Certain temperatures have to be maintained, and atmospheric air must be excluded, in order that the film of oxide produced shall be perfectly adherent to the surface of the iron. The steam, under the circumstances, is decomposed by the iron, producing black oxide of iron ($Fe_3O_4$) and gaseous hydrogen, which escapes from the heated chamber. The reaction is expressed thus:

$$3Fe+4H_2O=Fe_3O_4+4H_2.$$

The time needed to coat the iron surface with the black oxide of a sufficient thickness varies slightly according to the description of iron treated. At the end of seven or eight hours the film of black oxide is sufficiently thick for the purposes for which the iron is intended. I need not repeat the

description of the properties of this oxide. It has been abundantly proved that iron can be successfully coated in this way, and that the resulting product is proof against all ordinary and extraordinary corroding agencies. The result, in fact, is iron in a condition pre-eminently adapted for the purposes I am considering, and not subject to those limiting conditions which characterize galvanized iron. I also understand that the cost of production is not greater than that of the latter. There is, therefore, no reasonable ground for believing that a gasholder constructed of wrought iron, coated by Barff's process, should not have an almost unlimited duration, even if exposed to the highest atmospheric temperatures in the presence of any or all of the impurities of coal gas which have been noticed.

The only possible objections to its use are purely of a mechanical description. The coefficient of elasticity of the black oxide is not the same as that of metallic iron; and therefore, when a sheet of iron which has been thus coated is seriously twisted or bent, the oxide cracks and admits of corrosion of the iron at the base of the fissures. Severe hammering also destroys the continuity of surface of the oxide. Neither of these imperfections, however, is likely to prevent the successful use of the iron for the construction of a gasholder, provided a reasonable amount of intelligence is exercised by those engaged in building it.

The application of Portland cement as a protective covering for iron is due to Major Crease. The conditions originally observed in using the process are not adapted for our requirements, and it would appear that the inventor has been striving to modify the principle, so that cement in a fluid condition can be prepared and applied as an ordinary paint. In Mr. Douglas's recent paper the subject is so fully dealt with, both from a chemical and a financial point of view, that I shall give a mere outline of the process. A bituminous varnish analogous to coal tar is applied in a hot state to the clean iron. When the varnish is hard, a specially prepared form of Portland cement is applied by means of a brush, like an ordinary paint. When the cement hardens, it performs a double function—first, it lends support to the pitch beneath it, counteracting its viscous character; and secondly, it forms an additional coating, impervious in a great measure to water and gases. Supposing Crease's process to be applied to a gasholder in a hot climate, the first question which suggests itself is: How would the cement coating behave when subjected to excessive alterations of temperature? If the coefficient of expansion of the cement coating be nearly the same as that of the iron it covers, there is no danger of the cement becoming detached from the iron.

Iron tanks have been coated by the original process and used for storing water at all temperatures up to near the boiling point. At the end of several years the cement lining has been found perfect. This fact is of itself sufficient to show that the coefficient of expansion of the cement is practically the same as that of the iron. The great merit of the inventor's improvements consists in his producing a perfectly smooth and semi-fluid form of cement, which admits of being applied by means of an ordinary paint brush, and giving in a few hours a hard and impervious layer.

I cannot conclude without referring to a matter of historical interest. I am indebted to Dr. Percy for the information that Liebig contributed an article upon the corrosion of iron to the *Cornhill Magazine* for September, 1865. In it he says that the rusting of iron will not take place, even in moist air, unless carbonic acid gas is present. The magazine in question is not one in which such an article would be looked for, and this is the only apology I can offer for my ignorance of its existence.—*Jour. of Gas Lighting.*

## MIXED GOODS, SILK AND COTTON, WOOL AND COTTON, ETC.

By M. J. PERSOZ.

THE methods in use for finding the respective proportions of the different fibers in such goods vary a little in different laboratories, less, however, in the kind of reagents used than in the manipulations properly so called. In a general manner they consist in weighing a swatch of the cloth, submitting it to the action of boiling baths acidulated with muriatic acid, drying and weighing again, in order to find the proportion of dressing and of dye; then destroying the wool or the silk by means of a suitable solution, and finally drying and weighing the cotton, which is not acted upon by the solvent.

One of the delicate points of the experiment, apart from the repeated use of acid baths of different strengths, lies in the estimation of the degree of dryness at which it is proper to stop before weighing the swatch at the different stages of its treatment.

The best thing would doubtless be to dry it in the stove each time at 230° F., and to weigh it in the stove itself, but hitherto the appliances for carrying out this process are wanting. As for effecting the analysis upon a very small sample of the tissue, dried in the stove, and weighed between two watch-glasses, there might even then be a risk of error, considering the small weight of the material operated upon.

I will call to mind in passing that, in order to establish in an equitable manner the proportion of the component fibers, it is necessary to add to the dry weight of each the proportion of water which it would have contained normally.

According to the method which seems the most general, we begin by placing the swatch in a room little subject to atmospheric variations, and leaving it there for such a time that, on carefully weighing it twice after the interval of, say, a quarter of an hour, no sensible change is observed in the equilibrium of the balance. The weight thus obtained is the first result of the analysis.

After the treatment with the dilute muriatic acid the swatch is put to dry in the same room, and is then weighed again. Finally, the residue of cotton left after it has been exposed to the action of the solvent—caustic soda or chloride of zinc, as the case may be—is treated in the same manner.

Although this method furnishes results which are generally satisfactory, it does not present the desirable guarantees for accuracy. It is, indeed, assumed that during the whole course of the barometric pressure the degree of the hydrometer and the temperature remain invariable. But if only one of these conditions is changed when any of the three weighings is made, then the fundamental data of the analysis are no longer comparable, the swatch being in its original state, than when it has been stripped; and finally the residue of cotton not having been exposed to the same degree of humidity, the differences of this nature may be very sensible if a marked change of the weather has intervened.

The process which I have finally adopted as the safest and quickest is the following:

Suppose that a cloth of silk and cotton is concerned.

Three swatches are cut, of any convenient size, Nos. 1, 2, and 3, and weighed at the same moment. We will call their respective weights $a$, $b$, $c$.

Swatch 1 is set aside untouched. Swatches 2 and 3 are stripped as well as possible by means of acid baths, No. 2 being then wrung out and set aside to dry.

No. 3, while still moist, is treated with caustic soda or chloride of zinc, and the residue of cotton is dried in the air along with Nos. 1 and 2.

When, after the expiry of several hours, two concordant weighings of each show that the fibers are in a state of hydrometric equilibrium with the air of the room (*i. e.*, when they no longer either gain or lose moisture), the three weights of the swatches, Nos. 1 and 2, and of the residue, No. 3, are taken again. We will call these three last weights, $a'$, $b'$, $c'$.

These data, $a$, $b$, $c$, $a'$, $b'$, $c'$, enable us to calculate the results of the analysis.

If we knew the successive weights of the swatch No. 3, first in its original state, then after stripping, and finally when reduced to a residue of cotton, all in the same atmospheric condition, we should have all the data required to solve the question. But they may be easily calculated.

Let us call $x$, $y$, $z$ the supposed weights found at the close of the experiment. We have then:

$$x = c \cdot \frac{a'}{a} \text{—the original swatch,}$$

$$y = c \cdot \frac{b'}{b} \text{—the stripped swatch,}$$

$$z = c' \text{ the residue of cotton.}$$

Hence we deduce the percentage of dye, and of dressing, T A, and of cotton, C.

$$\text{T A} = 100 \cdot \frac{a' \cdot b - a \cdot b'}{a' \cdot b}$$

$$\text{C} = 100 \cdot \frac{a \cdot c'}{a' \cdot c}$$

The proportion of silk is shown as difference.

This manner of operating permits us to take account of the variation which may have occurred in the hygrometric condition of the air between the first and the last weighing. If this variation is null, $a' = a$ and the formula above will be simplified to

$$\text{T A} = 100 \cdot \frac{b - b'}{b}$$

$$\text{C} = 100 \cdot \frac{c'}{c}$$

If the variation, though not null, is very trifling, it may be neglected and the calculation simplified. The essential point is that we have the means of preventing a serious error, if, for instance, rainy weather has suddenly set in after dryness, or *vice versa*.

It is well to operate upon swatches weighing about thirty grains.—*Moniteur Scientifique.*

## BLACKS FOR GARMENT DYEING.

NOTWITHSTANDING the great diversity of simple or compound tissues which come under the hands of the garment dyer, they may, nevertheless, be arranged under heads having a sufficient analogy among themselves.

Setting aside the colors created by sub-classes, we may consider the goods which are pure wool, pure cotton, pure silk, and then the compound tissues represented by goods of wool and cotton, wool and silk, and, lastly, wool, cotton, and silk.

As regards the ground to be dyed, it may either be white, light colored, fast or fugitive blue, or fast or fugitive red.

Stuffs and tissues of wool or shoddy, whether of a white, light blue, or a fugitive red, may be considered as similar, and may be dyed either by the argol or the chrome process.

### ARGOL BLACK.

For 100 parts of goods to be dyed, take—

| | |
|---|---|
| Argol | 15 |
| Copperas | 5 |
| Bluestone | 3 |
| Sumac | 5 |
| Dry extract of logwood | 5 |
| Paste extract of fustic | 2 |

Boil for one and a half hours, lift, air, and let lie till the next day; then rinse well, and enter in a second bath of three parts of dry extract of logwood per 100 to be dyed, and boil for half an hour.

This black covers well, and is perfectly full. It requires very careful rinsing, that the goods may not soil when dry.

### CHROMATE BLACK.

This process cannot be too strongly recommended to the garment dyer. It gives very even shades, is much cheaper than the argol black, is easier to apply, and adapts itself better to the different grounds upon which it has to be used. For 22 lb. of goods, take—

| | |
|---|---|
| Chromate of potash | 10¼ oz. |
| Copperas | 15¾ " |
| Bluestone | 20¾ " |

Boil for an hour, lift, air, and let lie till next day, and then wash very thoroughly till the washings run away clean. Very unsatisfactory results may be obtained if the rinsing is imperfect.

It is then entered in a second bath composed of 20¾ oz. of dry extract of logwood and 5¼ oz. paste extract of fustic. The black is produced, as if by magic, and half an hour's boiling.

This black is exceedingly rich, with a bluish reflection, which gives it freshness; it gives back little color, and is rinsed with comparative ease.

Goods of this class with a blue ground may be dyed indifferently by either of these processes, taking a little more yellow color and a little less logwood.

The red grounds belonging to the same class are much better dyed by the chrome process. Shawls of a grain scarlet and madder-red trowsers (an article not common in England) always give good blacks by this process.

Goods of a harsh fiber, baize, etc., dye always well by this process, care being taken to mordant for one and a half hours instead of one hour, using in the second beck rather more wares, and adding a little sumac, galls, or extract of chestnut. The boiling in the dye-beck is also prolonged to three-quarters instead of half an hour.

There is one ground which occasions much trouble—the catechu, which forms the base of certain maroons and fast browns.

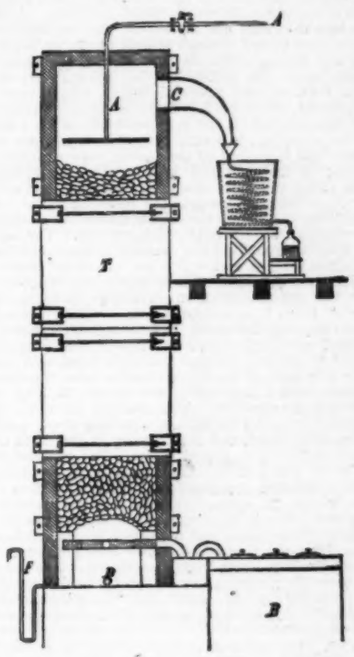
Here the argol process must be employed, for the chromate, though it deepens the original shade, never produces a black, but merely a very dark brown.

It may be useful to mention the method in which different-colored grounds may be brought down to very light shades, so as to admit of treating as if they were whites. This is useful if the original colors contained acids or powerful mordants, such as salts of alumina or tin. These may be completely neutralized by boiling with weak solutions of soda, say six per cent. on the weight of the goods to be dyed.—*Teinturier Pratique.—Chemical Review.*

## SEPARATION OF IODINE AND BROMINE.

By R. MULLER and H. BOCKEL.

A TOWER, T, built of stone, clay, or wood, is filled in the same manner as the so-called Glover tower, with coke, stones, or other similar substances, leaving, however, a free space both above and below. In the accompanying woodcut the uppermost and the lowest compartment of the tower are represented in cross section, showing the upper and lower limit of the layer of coke, etc. The liquid containing iodine or bromine, heated to a proper temperature, is introduced through the pipe, A, whence it is showered in a finely distributed spray upon the coke, while at the same time a current of chlorine gas, which is generated in the apparatus, B, and enters below, meets the descending liquid,




liberates the iodine or bromine, and converts the halogen compound into a chloride, which flows into the cistern below. The current of chlorine gas is so regulated that no free chlorine ever reaches the top layer of the coke; so there will be no chlorine carried over with the vapors of iodine or bromine. These latter, after being separated from the halogen compounds, rise, and pass through the wide neck, C, into the condenser, which, in the case of bromine, may have the construction shown in the figure. The liquid in the cistern retains a certain quantity of free chlorine, which is driven out by a current of steam, after which the residuary liquid is drawn off from time to time by the siphon, F.—*Dingler's Polyt. Journ.*

## THE COLORING MATTER OF SEA-WEEDS.

DYERS and colorists generally will be interested in a paper by M. Descourt, read at a meeting of the French Academy of Sciences. Attention has been drawn to the violet color of oysters obtained in the basin of Arcachon, which color has been attributed by some observers to the iodine and bromide which the water, it was conjectured, might contain in excessive proportion, owing to their concentration through the absence of rain, and the extreme dryness of the months of June, July, and August. M. Venot, an oyster cultivator of Arcachon, requested M. Descourt to endeavor to ascertain the real cause of this coloring. After several unsuccessful researches, M. Descourt's attention was attracted by a noteworthy circumstance. He had steeped some red algæ in a little of the sea-water with the object of studying them. Before proceeding to analysis, he washed the plants in distilled water, in order to clear them from impurities. To his surprise the water took a splendid carmine-purple tint, which was the more astonishing as the sea-water in which the algæ had been immersed for some days had no trace of discoloration. A more complete examination of the algæ, and of the colored solution, enabled M. Descourt to explain the peculiar color of the oysters. Examined under the microscope, the fronds of the algæ were seen to have a mass of spores of a beautiful carmine color. These communicated no color to the natural sea-water of the basin; but when the latter was sufficiently diluted it took from the spores a splendid rose color. Treated with alcohol and ether, a beautiful green coloring matter, similar to chlorophyl, was obtained. Treated with distilled or fresh water, a magnificent carmine-purple, slightly fluorescent, was produced. M. Descourt, therefore, concluded that the color of the oysters was due to the presence on the breeding-ground of a large quantity of these small algæ, which belong to the beautiful Rhodosperme or Floridæ families, genus *Rytiphlæ purpureæ* of Agarth. These algæ, says M. Venot, are very abundant on the Arcachon breeding-grounds, and cause considerable loss to the cultivators, as they attach themselves to

the valves of the young oysters and often carry these away. The spores furnish the animals with a very abundant but highly colored food. The mollusks assimilate the coloring matter, which is preserved, more or less modified, in the lobes of the mantle and the branchial plates, when the sea-water is not sufficiently diluted by rain to dissolve the dye. A year or two ago the whole basin of Arcachon was subject to extreme drought, and hence the violet color and peculiar taste of the oysters.

## SOURCES AND PREPARATION OF SHELLAC.

MR. VALENTINE BALL, in his recently published work, "Jungle Life in India, or Journeys and Journals of an Indian Geologist," gives the following account of the method of preparation of shellac and the source from which it is derived, subjects not generally known: Lac (or as it is called in Hindu tani, *lah*) is secreted by an insect (*Coccus lacca*) on the branches and twigs of certain jungle trees. The principal of these are the khusum (*Schleichera jujuga*), plas (*Butea frondosa*), and bier (*Zizyphus jujuba*). The lac from the first-mentioned, the khusum, is more highly esteemed than that from the others. To some extent the lac is found occurring spontaneously, and is collected by the forest tribes, and brought by them to the fairs and bazaars for sale. Where, however, there is a regular trade in stick-lac, propagation of the insect is systematically carried on by those who wish for a certain and abundant crop. This propagation is effected by tying small twigs, on which are crowded the eggs or larvæ of the insect, to the branches of the above-named species of trees. These larvæ are technically called "seed." The larvæ shortly after sowing spread themselves over the branches, and, taking up positions, secrete round themselves a hard crust of lac, which gradually spreads till it nearly completes the circle round the twig. At the proper season the twigs are broken off, and we must suppose them to have passed through several hands, or to have been purchased directly from the collectors by the agents of the manufacturer. On arrival at the factory, they are first placed between two powerful rollers, which, by a simple arrangement, admit of any degree of approximation. The lac is then crushed off and is separated from the woody portions by screening; it is next placed in large tubs half full of water and is washed by the coolies, male or female, who, standing in the tubs, and holding a bar above with their hands, stamp and pivot about on their heels and toes until, after a succession of changes, the resulting liquor comes off clear. The disposal of the liquor drawn off at the successive washings will be spoken of further on. The lac having been dried is placed in long cylindrical bags of cotton cloth of medium texture, and which are about ten feet long and two inches in diameter. These bags when filled have somewhat the appearance of an enormous Bologna sausage. They are taken to an apartment where there are a number of open charcoal-furnaces. Before each of these there is one principal operator and two assistants. The former grasps one end of the long sausage in his left hand, and slowly revolves it in front of the fire, and at the same time one of the assistants, seated as far off as the sausage is long, twists it in the opposite direction. The roasting before the glowing charcoal soon melts the lac in the portion of the bag nearest the operator's hand, and the twisting of the cloth causes it to drop into a trough placed below. The troughs used are simply the leaves of the American aloe (*Agave Americana*). When a sufficient quantity, in a molten condition, is ready in the trough, the operator takes it up in a wooden spoon and places it in a wooden cylinder some eight or ten inches in diameter, the upper half of which is covered with sheet brass. The stand which supports this cylinder gives it a sloping direction away from the operator. The other assistant, generally a woman, now steps forward holding a strip of the aloe between her hands, and with a rapid and dexterous draw of this the lac is spread out at once into a sheet of uniform thickness, which covers the upper portion of the cylinder. The operator now cuts off the upper edge with a pair of scissors, and the sheet is then lifted up by the assistant, who waves it about for a moment or two in the air till it becomes quite crisp. It is then held up to the light, and any impurities (technically called "grit") are simply punched out of the brittle sheet by the finger. The sheets are laid upon one another, and the tale, at the end of the day, is taken and the chief operator paid accordingly. The sheets are placed in packing-cases, and when subjected to pressure break into numbers of fragments. Such is the history of shellac from its birth in the jungle to its appearance in the world as a commercial article.

The dark red liquor resulting from the washing above described is strained in order to remove all foreign materials. It is then passed into large vats, where it is allowed to settle. The sediment is subjected to various washings, and at last allowed to settle finally, the supernatant liquid being drawn off. The sediment when of proper consistency is placed in presses, from which it is taken out in the form of hard dark purple cakes, with the manufacturer's trade-mark impressed upon them. This constitutes what is known in commerce as "lac-dye." By the addition of mordants, this dark purple substance yields the most brilliant scarlet dyes, which are not inferior to those produced by cochineal. The dye which is thus separated from the lac by washing is said to be the body of the insect, and not a separate secretion.

## A NEW HÆMOSTATIC.

A NEW hæmostatic mixture, which is likely to prove of some service, has recently been described by the Italian chemist Paveri. Its formula is as follows:

| | | |
|---|---|---|
| Sulpho-phenic acid | 25 | parts. |
| Rectified spirit | 25 | " |
| Benzoic acid | 5 | " |
| Tannic acid | 5 | " |
| Glycerine | 25 | " |
| Rose water | 200 | " |

The sulpho-phenic acid is prepared by mixing one part of concentrated sulphuric acid with half part of phenol, and heating the mixture for a few minutes at the heat of boiling water, that is, in a water bath. A few minutes at the temperature of 212° F. is sufficient to insure the combination when small quantities only are operated with; with larger amounts a little longer time will be required, and the mixture must be stirred.

The benzoic acid is dissolved in the rectified spirit, the glycerine and tannin in the rose water, and the whole mixed together. The mixture is quite clear, of a pale yellow color; its taste is acid, and caustic or astringent, but not irritating. It coagulates white of egg, milk, and blood.

This new hæmostatic is doubtless valuable on account of its antiseptic properties, as well as by its highly astringent quality. In this respect it is perhaps superior to the mixture of *perchloride of iron and chloride of sodium*, and also to the well-known *ferri-oxi-chloridi*, or ruby red solution of peroxide of iron in perchloride of that metal. These, however valuable, cannot possess astringent and antiseptic properties to so great an extent as the mixture just described.

## APPARATUS FOR DETERMINING THE QUANTITY OF WATER IN MILK, ETC.

THE apparatus described below by Dr. J. Petri and Dr. R. Müncke depends on the same principle as Geissler's lactometer, namely, the distillation of a known quantity of milk in rarefied air, and measuring (or weighing) the distillate. It consists of a closed metallic reservoir for water, A, which is connected by means of the rubber tube, *a g*, with the flask, B, closed by a triply perforated cork. The outlet, *d*, carries the vapors of water into the condenser, D, in which cold water circulates around the condensing tube proper. The middle perforation of the cork holds the burette, C, from which a measured amount of milk is allowed to run into the flask at the proper time. When making a water determination, the water in the reservoir is heated by means of the lamp, and the steam is allowed to pass through the tube, *a g* (the pinch-cock being open), into the flask, and from there through *d* into the condensing tube, until all the air has escaped, and nothing but pure steam issues from the

end of the condenser. The latter is then closed by means of the pinch-cock, the tube, *a g*, is disconnected from the reservoir and also closed by the pinch-cock. By means of a proper supply of water to the condenser, the remaining steam in the flask and tube is condensed and collects in the lower part of the condensing tube. As soon as the level of the condensed liquid remains stationary its height is noted, and immediately afterward a measured quantity of milk allowed to run into the flask from the burette. The water of the milk will, under these circumstances, rapidly distill over, and, when nothing more passes, its height may be read off. Deducting the amount of liquid previously obtained, the remainder will be the quantity, by measure, of water in the milk. If the milk was previously weighed the increase of weight in the condensing tube will indicate the water gravimetrically.—*Industrie-Blätter.*

## LUMINOUS PAINT.

AT a recent meeting of the Society of Arts, Professor Heiton, of Charing-Cross Hospital, gave a lecture on "Balmain's Luminous Paint." He commenced by stating the nature of fluorescent substances, showing examples of several under the electric light. Afterward he alluded to phosphorescence, and detailed the history of the investigation of phosphorescences. Becquerel, a Frenchman who lived about thirty years ago, discovered more than all the other investigators together, and Balmain, the inventor of luminous paint, had the advantage of studying at one time under him. The paint is made up either as an oil or water color, and its sensitiveness to light is such that, as was shown by experiment, a piece of painted cardboard exposed to the sparks of an induction coil shows in the dark a photographic record of the sparks. On being exposed to light under different colored glasses the paint displayed hardly any luminosity excepting when under blue glass. This proves that it is the actinic rays, as in photography, which affect the paint. Red rays, indeed, destroy the light, but it was shown that this is due to the heat developed overstimulating and exhausting it. A can of hot water had the same effect as red rays of light. Exposure to air or water does not affect the paint, and a painted-model life-buoy was shown which when placed in a jar of water retained its brightness. The lecturer stated that the paint was efficiently bright in the dark until from eight to ten hours after the time when it had been exposed to light. He illustrated its practical utility in various ways, one illustration being a diver who walked into the darkened room with his dress covered with the paint, which gave him a very phantom-like appearance. It was mentioned that at Southampton docks the divers had found the emitted light to be of much service under water. Professor Huxley, who presided, complimented the lecturer for his lucid explanation of the scientific as well as practical character of the paint. Mr. Balmain, he said, had been his intimate friend, and his name was remembered by all who knew him with veneration and affection. All felt his untimely death just at the moment when his patient researches commenced to bear fruit. In the discussion which followed it was suggested that a good use for the paint would be to paint shop window shutters and street vehicles with it. Two railway companies had experimented with it for painting carriages running through tunnels, and these experiments had been very favorable.

## LONGEVITY.

THE average of human life is about thirty-three years. One-quarter die before the age of seven. Of every one thousand persons, one rarely reaches the age of one hundred years, and not more than one in a hundred will reach the age of eighty. There are on the earth 1,000,000,000 inhabitants. Of these, about 38,333,333 die every year; 91,894 die every day; 7,789 every hour, and sixty every minute. The married are longer lived than the single. Tall men live longer than short ones.

## UNRECOGNIZED BRIGHT'S DISEASE.

By B. A. SEGUR, M.D.

AT the October meeting, last year, I brought to the attention of this society the subject of the prevalence of unrecognized chronic Bright's disease. The existence, particularly, of a latent, preparatory, forming stage of the disease, in which no deviation from usual health occurs, and to which no recognized sign, no warning signal, is assigned, was pointed out in most striking, emphatic language, quoted from and the concurrent testimony of the best authorities. It was also shown by the same testimony, and it is well known to every practitioner, that the early progress and not unfrequently the course of chronic Bright's disease, are equally insidious and unrecognized.

If the urine of every person who consults or is seen by a physician were examined for albumen, and if albumen were invariably present in the urine of persons subjects of the disease to which the name albuminuria is given, then our art and practice would be sufficient and clear.

Grainger Stewart writes: "Albumen is rarely present in any considerable quantity, and its presence fitful in its appearance and varying in its amount" in cirrhosis of the kidney.

"The simplicity of testing the urine for albumen, and so settling the question of the presence or absence of kidney disease, is so alluring, that many forget that it is only one symptom of renal disease." "The diagnosis of chronic renal disease during its quiescent periods (*that is, during the greater portion of its existence*")—the italics are mine—" is a matter involving much thought and care, much knowledge and observation, watchful attention and thoughtful pathological research, ere an opinion entitled to any weight can be reached, and yet there are those who will at once decide the matter by testing the urine for albumen, and if it be not present throw over forthwith all the other evidence—a plan calling for stern reprobation." "The man who would make the diagnosis of chronic renal disease turn on the presence or absence of albumen, is a man whose patient I should not like to be." "The silent progress of interstitial nephritis is often without albumen for long periods."—Pothergill, "Hand-book of Treatment," pp. 395-6.

The professional experiences of the past year have added new examples of quickly fatal courses and terminations after late recognition in persons whose previous health was good, but who were subjects of chronic renal disease. In one of these the urine had been examined, and the absence of albumen had misled the physician in his diagnosis. In two others albumen was absent and the disease progressed unrecognized until the vision became suddenly impaired. Quite recently I have seen two persons whose health was good until about three months ago dyspnœa, due to irregularity of the heart from associated hypertrophy, led to the investigation of the kidneys and the diagnosis of chronic renal disease. In these the urine gave all the usual evidences, in quantity, specific gravity, presence of albumen and renal tube casts, of the disease. In several the only general form of cast found was the hyaline or transparent. This was uniformly the case in the examinations of the non-albuminous urines.

I therefore feel now more and more confirmed in the conclusion stated last October: "That the hyaline cast is a very early and important means of diagnosis—as early and significant in its relation to the kidney as the mucous rale is to the lung."

I think in every stage of chronic Bright's disease the hyaline cast is present in the urine; and in those preparatory states of the circulatory, digestive, and organs of secretion and excretion which lead in time to organic changes in the kidney, it will also be found. I do not propose at this time to enter upon an inquiry as to the importance of hyaline casts, or their significance when found in the urine. I do not suppose that this or any form of cast necessarily indicates structural disease of the kidney.

But whether albumen is or is not present, the microscopic examination is indispensable in any study of renal pathology. When hyperæmia of the kidney exists, the hyaline cast will, I think, invariably show it, and often there is no other sign or symptom. If, in the absence of other signs and evidences, we may conclude that no important or permanent renal changes have taken place, still we should in every such case look for, and we shall often enough find, associated with the hyaline cast, as the primary cause of the renal hyperæmia, valve disease or cardiac hypertrophy, atheromatous vessels, pulmonary emphysema, chronic pleuritic effusion, cirrhosis of liver, chronic catarrhs of bronchial, gastric, or intestinal mucous membranes, stricture of urethra, renal calculi, the gouty habit, chronic alcohol or lead poisoning, etc., etc., together with many vague or so-called functional disturbances of the nervous, digestive, and other systems.

Regarded in this light, the hyaline has a daily and increasing practical value in my observations, not impaired by the fact to which I wish to give its proper recognition, that renal hyperæmia, and so the hyaline cast, is most often as transient and insignificant as is the bronchial hyperæmia of a common cold.

In microscopical examination of urine of men in good ordinary health, in active life, with its vicissitudes dependent upon habits and pursuits, I have found one in four to have hyaline casts on one or more trials.

It has occurred to me so often to find renal tube-casts in urine submitted to me for examination, when others, physicians practiced in the use of the microscope, have reported no casts in the same urine or in other urine from the same persons, that I wish to submit to the society the manner of my observations, so that those who are watching their patients and the families they attend for the earliest indications of renal affections, may, without too much expenditure of time, be certain that they have sufficiently sought for evidence afforded by the urine.

For, as is well known, the hyaline cast is not an abundant formation, compared with epithelial, fatty, and granular casts, which are shed from the renal tubes in some forms of kidney disease as abundantly as the peeling after eruptive fevers. One or two hyaline casts are often all that can be seen after a well directed microscopic examination.

Their transparency is spoken of as a reason why they are often overlooked. But I do not think, with the objectives at present offered by the best makers, it can be said there is any difficulty in seeing the so-called transparent casts.

It is the practice to take the portion for the microscopic slide with the pipette from the bottom of the urine. But urinary deposits are often *not* sediment, and I have many times taken portions from visible deposits floating near the surface or at various depths below, and found casts when the pipette, passed to the bottom, obtained none. Quite recently a member of our profession in the city of New York, of middle age, in apparent good health, who suffered a few months ago a slight impairment of vision, and then discov-

ered that his urine contained albumen and had a specific gravity of 1008, sought the advice of a distinguished consulting physician, who recognized the facts so far as related, but did not find any casts. In the urine submitted to me, after standing eighteen hours, I saw a light cloud floating in the urine near the surface. This contained numerous casts, but none were found from the bottom.

Again, casts may not be found in the sediment after six hours' standing, when the sediment of the same urine after twelve hours more may yield them.

When the microscopic examination of a single drop has failed me, a second or third, or some successive search, has repaid the expenditure of time.

To save time and to make a thorough microscopic examination of urine, I have found the following plan advisable:

The urine to be examined is placed in a tall conical glass. After three to six hours it is inspected. From the visible deposits, whether floating or sedimentary, with the pipette a quantity is taken sufficient to fill a concave slide or a shallow cell.

This little pool is first searched with a four-tenths objective, and in a little time any cast or other microscopic object it contains is found. A more careful observation is made of the object thus found with the one-fifth. I have used for several years, with satisfaction, a Swift one-fifth with sufficient distance between the object and the lens to easily examine the depth of a concave slide. I have found much saving of time in examining six or more drops at once. I have represented this advantage to Mr. Wales, and he has produced this one-fifth which I have been working with for two or three weeks, and which I offer for your examination tonight, with this description by Mr. Wales: "The one-fifth has an angle of eighty degrees aperture,* and a working distance of 0·06, or about one-sixteenth of an inch. It resolves pleurosigma angulatum perfectly and defines podura with equal satisfaction." I think this lens is especially interesting to physicians, because it adds to the usual requisite good qualities of definition, etc., the unusual working distance, as may be readily seen by looking at this mounted specimen through the thick glass slide, instead of through the thin glass cover.

When the examination of deposits has been made in this way, the conical glass of urine should be set aside (a little chloral may be added to prevent decomposition), and after twelve hours more the examination should be repeated.

Sought in this way, hyaline casts will be more frequently found than they have been hitherto, and then we shall obtain a better knowledge of the conditions in which they occur.—*Proc. Med. Soc. Kings County.*

* For physicians' uses this medium angle for the one-fifth, while it renders possible the increased working distance, is a positive advantage in focal depth, giving a distinct view at once of greater depths of urine or other object.

## ALBUMINURIA IN PERSONS APPARENTLY HEALTHY.

By JOHN MUNN, M.D., Assistant Medical Director United States Life Insurance Company, New York.

FOR several years past it has been the custom among many of our life insurance companies to require an examination of the urine when persons have made application for a policy, though only in cases where the amount was large, as, for example, $10,000 or over, or where, from the personal history or physical appearance, a kidney difficulty was suspected. From the fact that nearly ten per cent. of all the deaths of policy holders in the United States Life Insurance Company, from whose records these figures are taken, occurred from Bright's disease, it was considered judicious to require an examination of urine in as many cases as possible, with the view of ascertaining in what percentage of applicants the urine was abnormal. This work was undertaken in the latter part of 1877. The result was that so many cases of albuminuria were discovered among those presenting themselves for insurance, that an examination of the urine was deemed necessary in the case of each applicant, and accordingly an order to this effect was issued by the executive. This furnished the opportunity to study the urine of persons apparently in perfect health, and it was determined to make careful records of each case, using the most delicate means possible to detect any variation from the normal condition.

For our purposes, it was necessary to be able to discover albuminuria in its incipiency, and to do this special precautions were taken. It was found that after having boiled urine and added to it nitric acid, albumen, even though present in considerable quantity, might easily be overlooked if the test tube were not perfectly clean and bright, or if it were not held in a light properly shaded. It is not sufficient to hold the tube before a dark background, as is sometimes done, as the light from the window or burner dazzles the eye. It is necessary that the light enter the room through a comparatively small opening, and that it fall upon the test-tube, allowing the eye of the observer to rest upon a background entirely dark.

The ease with which one may detect any solid substance in a liquid may be readily appreciated when we remember how completely filled with floating particles the atmosphere appears when a ray of sunlight enters a dark room through a small aperture, while in the same room with open windows the air seems perfectly clear.

After many experiments, the following plan has been found to answer the purpose fully: I have placed immediately below the window glass, and extending up to it, a large square of black pasteboard. The dark window shade is then drawn down to meet the upper margin of this pasteboard, and carried out at the bottom about one foot. Immediately under this the test tube is held. By this method nothing but reflected light meets the eye. If any one will place in a perfectly clean test tube urine containing a considerable quantity of albumen, boil the upper portion, incline the tube to an angle of forty-five degrees, allow two or three drops of nitric acid to trickle down to the bottom, hold before an open window, or an unshaded burner, and afterward place in light reflected as described above, he will lose his faith in tests for albumen as ordinarily undertaken.

It is important that the acid should be carefully added, drop by drop, while the tube is in the reflected light, as in this manner the test is far more delicate. It has also appeared that albumen in a urine, alkaline, neutral, or even faintly acid, will not be readily detected. The urine must be distinctly acid, and when it is not, should be rendered so by the addition of acetic acid, and thoroughly well shaken before boiling. Unless this precaution is taken, albumen will be overlooked in many cases.

It is also necessary that the urine be allowed to stand quietly in the test tube at least five minutes after the nitric acid is added, at the expiration of which time, if no cloudiness appears, it may safely be pronounced non-albuminous. The following table is made up of cases coming under my own observation. The heart and lungs were normal in each, and nothing satisfactory was found to account for the albuminuria. Nor was there anything in the physical appearance of any, save possibly two, to warrant any suspicion of a renal disease. Each one considered himself in perfect health, and really appeared as if he were. They were all excluded solely on account of albuminuria, and formed eleven per cent. of those presenting themselves to me for examination. In nearly every case two or more specimens taken at different times were examined, and albumen found in each.

| No. of Case. | Occupation. | Age. | Weight. | Height. | Pulse. | Albumen. |
|---|---|---|---|---|---|---|
| 1 | Bank clerk | 23 | 125 | 5-8 | 76 | Well marked. |
| 2 | Commission merchant | 23 | 180 | 5-6 | 86 | Slight trace. |
| 3 | Lawyer | 23 | 138 | 5-7 | 78 | Abundant. |
| 4 | Public works | 29 | 245 | 5-9 | 108 | Abundant. |
| 5 | Commission merchant | 33 | 160 | 5-9 | 76 | Considerable. |
| 6 | Iron merchant | 33 | 175 | 5-11 | 80 | Moderate quantity. |
| 7 | Telegraphy | 33 | 152 | 5-8 | 84 | Well marked trace. |
| 8 | Physician | 40 | 165 | 5-8 | 84 | Moderate quantity. |
| 9 | Printer | 40 | 176 | 5-6 | 82 | Well marked. |
| 10 | Hay dealer | 41 | 185 | 5-11 | 74 | Abundant. |
| 11* | Bookkeeper in brewery | 41 | 210 | 5-10 | 85 | Moderate quantity, also sugar. |
| 12 | Woolens | 44 | 175 | 5-6 | 84 | Abundant. |
| 13 | Wholesale liquor merchant | 45 | 140 | 5-5 | | Considerable. |
| 14 | None | 47 | 167 | 5-5 | 92 | Abundant. |
| 15 | Insurance agent | 50 | 181½ | 5-9½ | 92 | Trace. |
| 16 | Safes | 52 | 257 | 5-8½ | | Albumen. |
| 17 | None | 53 | 140 | 5-9 | 88-90 | "Present." |
| 18 | Mechanical engineer | 54 | 180 | 5-10 | 108 | Considerable. |
| 19 | Dealer in velvets | 57 | 160 | 5-5 | 76 | Considerable. |
| 20 | Lawyer | 57 | 195 | 5-7 | 84 | Well marked trace. |
| 21 | Railroad president | 61 | 188 | 5-9½ | 84 | Moderate quantity. |
| 22 | Clothing | 61 | 160 | 5-5 | 84 | Moderate quantity. |
| 23 | Mercantile agency business | 61 | 161 | 5-9 | 78 | Well marked trace. |
| 24 | Publisher | 61 | 165 | 5-8½ | 66 | A trace. |

* Applied for insurance and was accepted in December, 1877; no examination of urine. Applied again in three months, but was rejected, both sugar and albumen being found in urine. Died three months later.

In a number of cases, the applicant having been advised of the cause of rejection, returned to me, saying that his family physician had examined a specimen of his urine, and found it perfectly normal. I have been able, however, in a few such instances—indeed, whenever a personal interview has been had—to convince the physician that the examination, as made by him, would not have detected any but a considerable quantity of albumen, and great surprise was expressed on demonstrating the case with which it is possible to overlook albumen, unless proper care is taken in the analysis. Such experiences have strengthened the conviction that tests as ordinarily made are far from being satisfactory, and I feel compelled to make this assertion boldly.

While it is impossible to deduce definite conclusions from the limited number of cases given above, it is interesting to note that albuminuria was found as frequently in the young as in the old, half the number being under forty-five years of age; that in nearly half the number there was excessive weight; that the pulse was rapid in nearly all, though very little importance may be attached to this. Casts were found in but two cases.

There is great difference of opinion as to what the clinical significance of albuminuria really is, but that it should exist in eleven per cent. of a large number of individuals considering themselves perfectly healthy and with no discoverable cause for its presence, is a fact worthy of consideration. When no discomfort is produced by it, our attention as physicians may not be called to these cases until a late period, when other manifestations of kidney disease appear. Consequently such cases are rarely observed. It is proposed to keep the cases here noted, together with such others as may come to my notice, under close observation; to examine the urine from time to time, and note whatever changes occur in it, and in the general condition of the individual.

By so doing for a number of years, we may hope to approach a little nearer to the real significance of albuminuria.

These investigations thus far seem to warrant the following conclusions:

1. Albuminuria does exist in a far greater proportion of individuals apparently in perfect health than is ordinarily supposed.

2. The method of testing, as commonly practiced, fails to detect any but a considerable quantity of albumen, and it is absolutely necessary to use light properly shaded.

3. The urine, if not distinctly acid, must be rendered so before boiling.

4. In an alkaline urine, unless properly acidulated before boiling, at least five minutes must elapse after adding the nitric acid before it is safe to pronounce it non-albuminous.

5. The early morning specimen frequently contains no albumen, while that voided later in the day does. Consequently a morning specimen, which physicians usually require for analysis, is not to be depended on in testing for albumen.

6. Carelessness in procuring specimens, which are often received in an unclean vessel, or placed in a partially cleansed bottle or in foul test tubes (unfortunately used by many physicians), renders the analysis untrustworthy.

The vessel receiving and conveying the specimen and the test tubes used in testing it must be absolutely clean; the reagents used must be chemically pure.

The production of bacteria is favored by uncleanliness in the urine receptacle. If such urine remains for a few hours in a warm room in a stoppered or unstoppered bottle, a cloud will appear, indicating the presence of bacteria in myriads. At this time no test for albumen is satisfactory. By careful filtration through many successive layers of ordinary filter paper we can remove many of them, but nothing short of porous clay is thoroughly successful. This latter method is obviously inapplicable. The moral is, never examine any but fresh urine for albumen.—*Medical Record.*

## CURE FOR COLDS.

WE published some time ago in this magazine a paragraph upon bronchitis, the result of some experiments made by a gentleman upon himself, and which his medical attendant said, jocularly, constituted a fraud upon the profession. This gentleman, who was subject to attacks of acute bronchitis, succeeded in warding them off by observing the ordinary precautions against catching cold, but especially by chewing a small piece of ginger whenever he was obliged to go out of doors on a cold day. Since he had adopted the plan of keeping a piece of ginger in his mouth whilst out of doors, he had never had an attack of bronchitis either winter or summer.

A very similar result has been obtained in coryza by an Italian gentleman, R. Rudolf, which makes us believe more in the above-mentioned ginger remedy than we felt at first inclined to do. The case is related in a recent number of the *Gazzetta Medica Italiana*, and the substance used was not ginger, but eucalyptus. Dr. Rudolf being seized with a severe attack of coryza, or in other terms a very bad cold in the head, happened to chew one or two twigs of the eucalyptus, at the same time swallowing the saliva secreted, which had a bitter and aromatic flavor. To his surprise he found that, in the course of half an hour, the nasal catarrh had disappeared.

Some days later the same person was seized with another attack, when the same treatment was followed by an equally fortunate result.

The author then prescribed this simple remedy to several of his patients, all of whom were benefited in the same way. He adds that, in his opinion, this treatment is only suitable to acute cases; that appears probable enough, but if such simple aromatic substances as ginger and eucalyptus will cut short or prevent an attack of bronchitis or coryza, we consider that a very useful discovery has been made, and that it cannot be too widely known.—*Monthly Magazine.*

## INFECTIOUS PNEUMO-ENTERITIS.

IT is estimated that $20,000,000 are lost to this country every year from infectious pneumo-enteritis, or, as it is popularly called, hog-cholera. The disease is more extensive and malignant than any other of the common affections of domestic animals. Its study, therefore, is very important from an economic point of view. It has peculiarities, also, which give it a great deal of pathological interest. The labors of Klein in England, and of Detmers and Law in this country, under the direction of the U. S. Commissioner of Agriculture, have brought out many new facts, and our knowledge of the disease is now tolerably full.

Infectious pneumo-enteritis, as it is called by Klein, has been known in Europe for over a century; it has ravaged the herds of the United States for thirty or forty years.

It is a purely and actively contagious disease, manifesting itself with the symptoms of a continued fever, bronchial and pulmonary inflammation, more or less enteritis, uniform involvement of the lymphatic system, and some one or more of the serous membranes of the trunk.

It varies much in virulence, but an ordinary attack comes on slowly. The pig becomes listless and inactive, loses its appetite, and is generally constipated; the thin parts of the skin become reddened, and finally petechial; the inguinal glands are always swollen; cough develops, and rapid respiration; the thermometer shows a high fever, and, later on, examination may detect consolidation of the lungs. The animal emaciates; is disinclined to stir; it shows evidences of pain in the abdomen; mucus hangs about the mouth; the eyes are bloodshot; a specific offensive smell is emitted; it staggers about, and finally drops down to die of exhaustion. The disease lasts from one to two weeks.

About eighty per cent. die, and those that survive are rarely of any further use. Upon a post-mortem examination, evidences of bronchitis, and of more or less lobar and lobular pneumonia, are found in the lungs. In earlier stages, many small emboli are found, which swarm with a peculiar kind of bacteria, called by Detmers *bacilli suis*. In the intestines are pathognomonic changes in the form of morbid growths upon the walls of the cæcum and colon. They sometimes occur in other parts of the alimentary canal, and even upon the conjunctiva and parts of the skin where there have been wounds. These little tumors are round, more or less elevated and pedunculated, and vary in size from that of a pin's head to a quarter of a dollar. They are composed of proliferations of the intestinal epithelium, contained in a stroma of new connective tissue. They are soft and easily broken down. The *bacilli suis* are described by some as swarming in the midst. The lymphatic glands are enlarged, and the pleura, pericardium, and peritoneum, are either one or all affected. The morbid changes vary greatly in the prominence with which they affect the different organs. Sometimes it is the lungs chiefly, and sometimes the intestines or serous membranes; but the most constant pathological changes are in the lungs and intestines. The blood is said to contain many bacteria of the kind mentioned.

The infecting poison is a very active one. It may enter the system by the lungs or the stomach, or it may be inoculated. It is easily decomposed, but cold only locks up its powers without destroying them. It affects other animals than swine, notably the mouse, which, being diseased, may carry the contagion. The infectious principle exists in the secretions and organs, but it is doubtful if the blood is al-

ways infectious. It may be carried by water as well as by air. Klein discovered it to be a particulate body; Drs. Detmers and Law seem to think it is a variety of bacteria, the *bacillus suis*, an organism which was cultivated and studied microscopically by them. A belief in the fact that this organism is the *contagium virum* is asserted with a positiveness not warranted by the facts.

Dr. Detmers cultivated these *bacilli suis*, and describes them as at first minute round bodies, or bacilli-germs, about 0·0007 mm. in diameter. These gradually lengthen into rod-bacteria, which become very long, and then, breaking up, give birth to numerous *bacilli*-germs again. These sometimes have a tendency to unite into viscous clusters. It is suggested as most probable that such clusters are formed in the narrow capillaries of the lungs, constituting the emboli there found; these emboli subsequently set up a pneumonia.

As regards treatment, it seems to be the wisest plan not to attempt any. Rigorous precautions should be taken to prevent the disease; but, if it has once entered a herd, all attempts at dallying with the poison are unwise. As soon as a pig is discovered to have the disease, it should be removed from the herd, and when dead, should be buried deep in the ground. The poison incubates from three to fifteen days, and the latter period of time must be waited before one can be sure that the herd is safe. Disinfectants should be freely used among the animals, chloride of zinc being probably the best. By vigorous measures of this kind the disease may be stamped out eventually. It should be the duty of the State, or general government, to make laws against the selling or transportation of the diseased animals.

The report of the Commissioner of Agriculture, which contains the results of his investigations of this disease, and from which we take many of the above facts, is an extremely creditable one. It is illustrated with micro-photographs and colored lithographs, the latter being exceptionally good specimens of a generally inane branch of art. The pathological work has been very conscientiously done, and, though showing some crudeness in the matter of its theories, makes, on the whole, a valuable contribution to the science of morbid processes. The fact that within two months the United States Government has published three works of high scientific interest is extremely gratifying.—*Med. Record.*

## THE VACCINATION DELUSION.

*To the Editor of the Scientific American:*

An article recently appearing in your columns exhibits an endeavor to discredit the position and purposes of the adversaries of vaccination. What it denominates "a craze against vaccination as a preventive of smallpox," is the honest sentiment unequivocally uttered and never refuted of some of the ablest scientists and scholars of the Old World. Baron Alexander von Humboldt, Prof Ennemoser, Prof. Bock of Leipzic, Prof. Kranichfield of Berlin, Dr. Siljestrom of the Swedish Parliament, Prof. Hamemich, Prof. F. W. Newman, Ricord. Kolb, Hufeland, belong among the number. "I have clearly perceived the progressive, dangerous influence of vaccination in France, England, and Germany," writes Humboldt to the president of the Anti-Vaccination League of London. Such are the men called "fools," whose testimony we are urged not to accept, and who seem to be unable to "shake confidence in proper vaccination," whatever that may be.

That vaccination induces and predisposes to consumption, scrofulous disease, chronic weakness of the entire alimentary tract, erysipelas, etc., and to increased mortality generally, we have the testimony of Sir Thomas Watson, Sir James Paget, Copeland's "Medical Dictionary," Dr. Dongan Bird, Dr. J. J. Garth Wilkinson, John Hunter, Dr. Constantine Hering, Dr. B. F. Cornell. Such European physicians as St. Gervais, Hufeland, Hertwig, Most, Grisolle, Canstatt, Beduar, and others enumerate some thirty dangerous diseases as the result of vaccination. Croup, diphtheria, scarlatina, female difficulties are now common as never before. I think it fair to impute this to physiological degeneracy, the sequel of blood poisoning. Vaccination is just that—nothing short of it, and, I firmly believe, nothing better.

Every boast which is now made of American methods has been made of every method heretofore employed. As for any practical stamping out of smallpox in this city by it, the idea is incredible, because it is impossible. Smallpox has been epidemic here, and doubtless will be again. In such an event it is safe to predict that vaccinated persons, as heretofore, will be found as liable as others to attack, if not more so. The writer has witnessed several cases of variola. The patients had been vaccinated with bovine lymph (?) and had pustules.

"The idea of extinguishing smallpox by vaccination," said Dr. Gregory, director of the Smallpox Hospital in London, "is as absurd as it is chimerical; is as irrational as it is presumptuous." He refused to permit his children to be vaccinated. A person having had smallpox once is not thereby exempt from having it again. In 1867 ten patients had smallpox at the hospital in London who had had it before and been vaccinated into the bargain.

Edward Jenner himself, having declared cowpox virus a thorough and perpetual preventive, had the chagrin to witness several whom he had so vaccinated contract smallpox. He acknowledged then that inoculation with bovine virus had no efficacy in preventing variola. "American methods" certainly can do no better than Jenner. In 1802 Jenner got a dotation of £10,000 for his discovery. Some time afterward a doctor visited Jenner, and was playing with his vaccinated child. The visitor happening to remark that he had just come from visiting a patient having smallpox, Jenner, in horror and alarm, compelled the child to leave the room. That was his faith, and it is almost all the faith we ever witnessed in anybody.

The facts being such, it is about as well to let them have full weight, and to give those who honestly and intelligently except to vaccination that respect which is due to honest convictions. We are not fools in this matter, and *they who denounce us know it.* I will waive all reference to virus obtained from the polluted subjects of scrofula, syphilis, cancer, leprosy, and the like. To procure it from sick calves is bad enough for any sensitive stomach. Any diseasing of a healthy person, under whatever pretext, willfully done, I must believe and declare, without equivocation, to be a *crime.* So believing, I speak, and decline being browbeaten into silence.

I will add one word more: When smallpox shall be treated rationally according to methods now known, saying nothing of others which may yet be discovered, it will be found to be neither a very dangerous disease nor a malady not easy to overcome.

Yours truly,
A. WILDER, M.D.

607 Broadway, Nov. 17, 1879.

## A SINGULAR DISEASE.

A curious case of mental and physical disorder is reported from Millersburg, Kentucky. The patient, a delicate girl, fifteen years old, has suffered from spinal trouble for several months. Her physician, Dr. T. D. Eads, reports that a supersensitive nervous condition prevails much of the time, but occasionally she is able to move about the house on crutches. About the first of February the disease took on some specially curious phases. At irregular intervals, sometimes in the morning, but generally in the early evening, the girl to all appearances falls asleep, always on her right side, with her right arm doubled under her head. Her eyes close, her breathing becomes short and spasmodic, and low moaning escapes her lips. The muscles above her eyes twitch convulsively, and her mouth is frequently thrown to one side. While in this condition she manifests a sort of double consciousness. The nervous sensitiveness vanishes or is deadened, and she has been known to jump out of bed and walk about the house unaided and without apparent effort. When in her normal condition the weight of a person's hand laid upon any portion of her spine will cause her to scream with pain. In the abnormal state a brisk rubbing of the back is unnoticed. Naturally, she is shy and quiet in manner, choice in her selection of words, and intelligent in conversation. In the somnambulistic state she is the reverse, romps with strangers, talks with an infantile lisp, has the pettish, willful manner of a spoiled baby, and reasons like a child. When herself she is fond of reading the more abstruse books, poetic and prose masterpieces. Abnormally, she cares only for nursery rhymes and books written for little children. But there is also another phase of this strange condition. She will frequently call for her books and slate and proceed to study her lessons, do difficult sums in arithmetic, write letters to relatives, etc., all with her eyes closed entirely. She recently wrote a letter of four pages to a relative, and, on reading it over, corrected several misspelled words. While in this state of somnambulism she calls Dr. Eads and his wife her pa and ma, and calls her real parents grandpa and grandma. Dr. Eads has attended her from early infancy. When aroused from this strange state she is always laughing, and before waking has frequent romps with those near her bedside. When awake she has no recollection of what she did or said in the somnambulistic state. When awake she writes with her right hand altogether, and when asleep she writes with her left hand altogether, and in either state pens a fine but very different handwriting.

## NEW BARKS.

WE gave in our last issue the account of a new alkaloid extracted from the bark of *Alstonia constricta*, a tree which is widely distributed throughout Australia, the bark of which was supposed to contain quinine. We have seen that it was not quinine, but another base very similar in properties and composition to that alkaloid. In another tree of the same genus, *Alstonia scolaris* or *Echites scolaris*, exists a substance which Gruppe took for an alkaloid, to which he gave the name of ditaine, the therapeutic effects of which are also similar to those of quinine. But this ditaine turns out to be a substance of a complex nature, containing a definite principle, *ditamine*, which acts on the animal economy like curare, and which it would be very dangerous to use as quinine. This particular bark was carefully studied a few years ago by Messrs. O. Hesse and Jobst.

The former chemist has more recently investigated another bark, namely that of *Alstonia spectabilis*, which is known at Java under the name of *poelé*. This bark, according to M. Scharice, contains an alkaloid that he described under the name of alstonine, for which Hesse proposes that of *alstonamine*. The base appears to be to ditamine what cinchonine is to quinine.

Another new bark which was stated to contain quinine is that of a plant of the rubiacise, rather abundant in Soudan, *Crassopteryx kotschyana*, or *C. febrifuga*. This bark certainly yields an alkaloid, but it is not quinine. About 0·018 of white amorphous alkaloid named *crassopterine* was obtained by the process of the Belgian chemist, Stas. It is soluble in alcohol and ether; its alcoholic solution is alkaline, and the hydrochlorate very bitter. Ammonia throws down a precipitate soluble in excess of ammonia. Soda produces the same amorphous precipitate, but insoluble in an excess. The chloroplatinate and chloraurate are amorphous precipitates. The solutions of crassopterine are likewise thrown down by iodomercurate of potash.

What gave rise to the idea that this bark might contain quinine was the blue fluorescence of the watery extract; but this fluorescence has been found to be due to some other principle in the bark and not to the alkaloid, which is soluble in ether; for when the solution is shaken with ether the fluorescence is not destroyed.—*Monthly Magazine.*

## HEALTH IS WEALTH.

IN a recent lecture in New Haven on the value of sanitary work, Professor BREWER, of Yale College, reviewed at great length the causes and effects of plagues and pestilences that did so much to darken the history of Europe during the Dark Ages. He then traced briefly the origin of sanitary science and its benefits, as shown in a largely diminished death rate. And after pointing out the four great obstacles to sanitation—ignorance, filthy habits, selfishness, and indifference—he proceeded to show how sickness, especially avoidable sickness, tends to impoverish communities as well as individuals. In this connection he said:

"Every student of history and of political economy notices the wonderfully rapid accumulation of wealth and capital in modern times compared with what it has been in previous ages. The material wealth and working capital of the civilized world has more than trebled in less than a lifetime. The accumulation of wealth and property (and it is this which represents the aggregate savings from labor) during the last few years more than equals all that had been saved in all the thousands of years that had gone before, and that, too, while there has been a more general enjoyment of the comforts of life and a much greater indulgence in its luxuries. The nature and sources of this rapid growth have been the subject of much discussion by statesmen and political economists. The causes generally assigned are the invention of modern machinery, the use of steam as a motor, the growth of modern means of transportation by sea and land, the application of the natural sciences to the arts and industries, the spread of popular education, the diminution of wars, and the production of the precious metals. There is no doubt that each and all of these have had their influence; but there is one still greater cause which is too often overlooked, simply because it is not so conspicuous. The greatest of all causes is to be found in the better average health of civilized countries, and the longer average term of life which is now secured to workingmen.

"It was not merely war, nor because they did not have steam, nor did not know about greenbacks, that kept the masses in poverty all through the Middle Ages—it was disease, and the death that came from disease that kept the nations poor. The history of the Middle Ages is a sad succession of plagues, of cities devastated, of states impoverished, of laborers swept away in millions, by successive waves of pestilence that followed each other as often as cities grew populous. Between the common sickness which was ever present and the pestilences which swept off their millions at a swoop, the average period available for actual labor in man was perhaps not more than half what it is now. Meanwhile, it took just as long to rear children to a working age as now, and sickness was just as expensive; so, between the diminished power of production, the waste by sickness, the panics and checks to commerce caused by plagues which were raging somewhere all the time, it is no wonder that wealthy people were comparatively few and the masses sunk in abject poverty. If we are tempted to think that we are saved from this by steam or machinery or increased production of the precious metals, let us look at any pestilence-stricken city of modern times. A single pestilence of but a few months came near bankrupting Savannah, and laid a check on her progress and a burden on her resources which it will take many long years to overcome. Worse still is the case of Memphis, with its two pestilences; and such may be the loss to any American city if it neglects sanitary laws. Our modern civilization is one of intense competition. Each producing community is now in a struggle with all the rest of the world as it never was before. If it have any special advantage, it may prosper; if it have any special disadvantage, it either lags behind in the swift race, or, by standing still, relatively declines, or else it goes under in the hard struggle of productive or commercial competition. And what heavier burden to bear than sickness! And yet this fact is liable to be overlooked or forgotten. The healthy man hopes that sickness will never come, and may be careless of his health, and the healthy community rarely awakens to danger until epidemic sickness sets in, and then the loss is actually begun.

"It is the part of sanitary science to point out the dangers and suggest means of prevention, and when epidemics actually set in to suggest remedies; it is the part of sanitary legislation to provide means to apply these remedies; it is the function of health boards to administer them. But, from the nature of the case, the better they do their work the less obvious are their labors. The officer who heroically stands at his post during the time of pestilence, labors to stay its dread work, helps the suffering, and comforts the dying, is a hero, and the heroism is of a kind that can be seen; no praise is too high. But the other officer who, by his labors, prevents the pestilence and keeps it so far off that the danger is scarcely seen, receives no such praise—too often in its stead criticism, opposition, and indifference. It is because of the nature of sanitary work that its value in increasing the prosperity of a city is so often overlooked. In the ordinary pursuits of business, the clang of machinery, the brilliancy of the applications of science to the arts, the bustle of business, the romantic ways in which the precious metals have been discovered and won, are more conspicuously in the eyes of the public than the quiet, persistent, unromantic, but heroic fight with unseen but unwholesome influences which lurk in the air of our towns. These malicious influences, mostly growing out of our modes of life, are ever present in all our cities, ever growing unless checked, always producing disease, and from time to time especially inviting pestilence, as persistent as sin, as tireless as nature, and as pitiless as death. The rapid growth of town and city populations, as compared with the country during the last forty or fifty years has been made possible only by the power which modern sanitary science gives us to prevent, to check, and to combat epidemics. As matters were before, a pestilence of but a few weeks or months would put back the growth of a city for years. This city has had but one visitation of yellow fever; it lasted scarcely two months, and, from all I can ascertain by a careful investigation of the matter, it took from eight to ten years to recover from that shock. Indeed, can we say that it ever recovered? What New Haven might have been, had it not been for that check, just at a time of rapidly-growing commercial importance, we can never know, but that citizens left, with their capital, to go into business elsewhere, and never came back, and that trade left the place and never returned, is certain. What 'might have been' had this pestilence not fallen on us eighty-six years ago we can never know. What may be, if another pestilence comes, we know too well. Too many cities have had such a bitter experience, even in modern times, for us to be ignorant of the effects.

"We insure our manufactories from loss by fire to insure their being rebuilt if once burned. Even with this, the temporary suspension of work may drive trade elsewhere. Hence premiums are cheerfully paid to guard against the possible contingency, and before the conflagration comes we cheerfully purchase fire-engines and apparatus, and organize bodies of skilled men to use them when the emergency comes. Here it is recognized that all this, though expensive in the beginning, is cheap in the end, and yet how reluctantly any such means are taken to guard against a worse destroyer of our wealth and prosperity. The arguments used even by official bodies against adequate support of public health administration in many, if not most cities, are curiosities of inconsistency, and will be cited as such by the next generation. It must not be forgotten that health boards are now more strongly demanded and called for because of their pecuniary importance than because of their function in allaying human suffering or saving human life. So long as merely men died, and health was lost, and sorrow fell on thousands of homes, Memphis went on as of old, dug her cesspools deeper and more of them, and did without sewers, but when the loud voice of trade cried out, 'We cannot afford to allow Memphis to longer stand as a menace to the commercial prosperity of the great Mississippi valley,' then, and not till then, was a system of sewering begun. A high death rate means loosened vigor, lessened powers of production, a check on prosperity, a burden on industry. A low death rate in modern cities can only be secured by public sanitation, and by an intelligent and efficient cooperation of the public with an active board of health. A single epidemic but one-fourth as bad as that in Memphis last year would cost this city more, and leave us with higher taxes, than the most expensive system of sewers and of garbage collection than was ever dreamed of here. And there is nothing to prevent it but public sanitation. We had that very disease here once, and the city did not recover its prosperity for ten years, and it lost some phases of prestige which it never regained. An epidemic of small-

pox a few years since lost to the city of Philadelphia, in ways which could be estimated, above $30,000,000. This city a little later was seriously threatened with a similar epidemic, which was effectually stayed, and the health officers were, perhaps, more severely criticised for their work than for any other thing they have ever done. The results, however, have amply demonstrated the wisdom of their action.

"The fact wants to be kept before the public, that as production and commerce and trade are now carried on, few cities can afford to allow a pestilence to invade them. And if it comes to a city, with the natural advantages of soil and climate we have, it is due either to official ignorance or public neglect. There is, perhaps, not a single kind of pestilence which has afflicted any civilized city of temperate climate during the Dark Ages or since, over which we have not now control, if the community act up to the light and knowledge we have; and on the other hand, as business is now carried on, no city can now be so afflicted as many then were, and not be bankrupted and financially ruined."

## DISPOSAL OF CITY GARBAGE AT NEW ORLEANS.*

By Rev. HUGH MILLER THOMPSON, D.D.

WE have choice of three ways to rid ourselves of the sewage of a city, but whether we choose water carriage, pneumatic pressure, or the scavenger carts, the garbage still remains. There seems to be no way to remove this but by the shovel and the cart. The question, then, about garbage, does not concern so much its removal from our streets and about our dwellings as the disposal of it after such removal. A favorite method in New York was, and I am not sure but it is still, to use it to fill lots—sunken below the street grade. The deposit of hundreds of tons of mingled ashes, cabbage stalks, rotten potatoes, and other kitchen refuse, mingled with dead cats, rats, and the like, as a foundation for a future dwelling, does not strike one as being a wise sanitary proceeding for the present or the future, nor one that commends itself to the tastes or nostrils of a civilized people. Still, one can see that in such disposal there is an element of economy which commends itself to the merely business mind. The lot needed filling, and kitchen sweepings were a convenient and cheap material. It is not, to the strictly business mind, and especially to the official mind, any part of its business to look further. If, as in New York, where earth and rock are easily obtainable, such a practice was found economical, it is no wonder that in New Orleans, where clean dirt is very scarce, exceedingly dirty dirt should be used in its place.

There was a "dumping-ground," so-called, established back of the narrow city on the edge of the swamp, and thither were brought the dead dogs and cats, the kitchen garbage and the like, and duly dumped. This festering, rotten mass was picked over by rag-pickers and wallowed over by pigs, pigs and humans contesting for a living in it, and as the heaps increased, the odors increased also, and the mass lay corrupting under a tropical sun, dispersing the pestilential fumes where the winds carried them.

But streets needed filling, and lots also, and here, to the official eye of the contractor, was a quarry, ready at hand for the purpose. Will it be believed that, actually, this horrible compound of offal, carcasses of animals, refuse of kitchens and sinks—this mass of reeking abomination—was carried back into the city and used to make streets and fill up hollows; dumped back again before the doors and windows of people who had not been sentenced to death for any crime!

In the letter to the Board of Health upon the subject of a complaint that a street contractor was "burying dead dogs, etc., in the middle of Jackson and Phillips streets," the administrator of improvements (!) defends himself by saying: "It has been a long-established custom to deposit offal, etc., on vacant squares in the various districts of the city. I believe it to be an advantage to place them on some of the low streets, where, mixed with ashes, etc., they can be used in raising the grade of such streets and rendering them passable!"

The officer was only carrying out the traditions of his office, doing as everybody else had done, in thus disposing of offal, garbage, and carcasses, and but for the epidemic of 1878 which followed, it might be going on still.

When the Auxiliary Sanitary Association was formed last year, one of the first practical questions which came before it was the disposal of garbage and offal. That the hitherto prevailing practice of utilizing it for street making and lot filling would not answer, was pretty well settled. Whether the yellow fever of the previous summer was or was not intensified by filth, the association did not care to debate. On the general principle that rotten garbage and dead dogs are not healthy compost for macadamizing the streets of a great semi-tropical city, they determined to dispose of these substances in some other fashion.

There was talk of cremation. It seemed impractical and expensive. There was talk of utilizing the garbage by converting it into a fertilizer—a beautiful and attractive plan, which, clearly, in the rich lands of Louisiana at least, would not pay, and which would still necessitate the use of a "dumping ground" and the handling and picking over of the filth.

There remained the river. It runs by New Orleans with a velocity of from two to four miles an hour. Its depth is between 100 and 200 feet. It is a vast, swift body—the accumulated drainage of half a continent. It was seen that nature had provided, as usual, for man's needs, if only man had the sense to use the provisions. Once in the Mississippi river, the garbage would be sent about its business for good.

The daily accumulation is about five hundred cart loads. The city is narrow and long, having a river front of seven miles, closely built.

The Auxiliary Association built and presented to the city three scows, costing $1,550 each. They are placed at special wharves along the harbor front, and to them the garbage carts are driven, and into them dump their contents. At 4 P.M. each day a tug picks up the scows, tows them two miles down the river below the city, where the garbage is dropped into the stream, and disappears in the devouring jaws of gar, pike, codfish, and the other greedy denizens of the great stream, which attend in countless numbers at their daily dinner hour. What is spared by them is whirled away into the waters, and not a trace of any part of the offensive matters can be discovered four miles below.

The scows are thoroughly washed out by the powerful steam pump of the tug, and, clean, sweet, and odorless, are returned to their respective wharves.

These scows have so thoroughly performed their duty, and have proved themselves, in rough weather, such good sea-boats, that an explanation of their construction may not be amiss.

The scows are 60 feet long by 22 feet beam over all on deck; bottom 50 feet long by 20 feet wide, raking fore and aft 6 feet; depth, 8 feet; dump compartment, or hold, 36 feet long to bulk-head. Capacity, 250 cart loads.

Two doors on each side swing on strap hinges, and are fastened by sliding bolts. It is found that these bolts can be raised without difficulty, permitting the doors to swing freely outward, causing a sudden and complete discharge of the load.

The boats are loaded from a wharf which projects over the boat to the center, fore and aft. When the carts are dumped their contents fall equally into both sides of the hold, the floor of which slopes to each side to an angle of 45 degrees.

It will be seen that, the load pressing against the doors, it is only necessary to raise the bolt in order that the contents should slide instantly into the water.

* Lately read before the American Public Health Association.

## ON ROTTING WOOD.

By Professor WM. H. BREWER, of Yale College, and President of the Board of Health of New Haven.

WHILE carrying on a series of experiments on certain physical characters of American woods, some facts have come out in so strong a light, and of so much sanitary interest, that I think it well to bring them before this association, even though the facts be not absolutely new. The aim of the experiments is a quantitative determination of the hygrometric characters of certain woods, the amount of sap contained in green wood at various seasons of the year, the relative amount soluble in cold water of matter contained in green and in seasoned woods, etc.

It is well known that all woods contain certain nitrogenous, organic compounds, known chemically under the general name of *albuminoids*, and that these substances are active in inducing and favoring rot. All chemical methods for the preservation of timber from decay look towards getting this nitrogenous portion into some less soluble condition, or into some combination less liable to chemical change. When green wood is well soaked in cold water, a considerable quantity of such albuminoid matter is dissolved out, remaining in solution in the water. This solution, even when very dilute, is extremely putrescible—more so, indeed, than any person present would deem possible, until he had tried the experiment (and it is an experiment I would advise you to make). The fact is as true of the hardest woods, as maple and locust, as it is of soft wood, like magnolia.

To illustrate: if a few pieces of such green wood, say of locust (I cite this species because it is a hard and particularly durable wood), be carefully freed from bark and all foreign dirt, and put into the purest cold water—even distilled water—and let stand at the ordinary temperature of our climate, or our rooms, if the temperature at times rises to say, by day, 60° or 70° Fahr., the water soon begins to become turbid or opalescent; this opalescence increases, in two to four days a thin pellicle forms on the surface, active putrefaction sets in, along with an abundant growth of the septic ferments, and the liquid soon becomes peculiarly and pungently stinking.

Without any visible evolution of gas, the liquid becomes very offensive to the smell, even when very dilute. The odor naturally varies with the kind of wood used, but in all cases I have tried, it is very rank, I think fully as much so as the same amount of *animal* matter in solution would produce. The intensity and rapidity of putrescence vary, of course, with the temperature, the kind of wood, the degree of concentration of the solution, and probably with the amount of tannin and other similar extractive matters contained in the original wood.

As in the case of other putrefaction, what the gases are which produce the stinking exhalations, we are entirely ignorant. It is probable that they are organic compounds of simpler molecular constitution than the albuminoids which furnished the necessary elements; and it is also probable that, as in other smells, the absolute amount exhaled is very small compared with the results produced on the senses.

If kept long enough, and of sufficient concentration, there is an abundant fungoid growth in the solution, and if kept in the light it grows darker in color, gradually becomes sour to the taste and smell, but continues offensive in odor for a long time, I know not how long, but in bottles partly filled, it certainly continues to smell bad for two years. Where the solution is kept in the dark, the odor seems more offensive than if the decay goes on in the light, but in this direction my experiments have not been nearly so numerous.

In the free air and full sunlight (and that is the condition to which piles and various other wooden structures and vegetable matter in swamps are subjected) along with the putrescence, a white fungous growth begins on the surface of the wood, which rapidly becomes slimy. This forms much more abundantly on the ends of the grain of the wood than on either the radial or tangential sides. If the solution is poured from the wood and kept in a separate vessel, and in the light, it grows dark, as already described, but the fungous growth goes on, modified, of course, by the temperature and the degree of concentration, and it continues offensive for an unknown period, or until the decay has become complete.

If the wood continues to be placed in successive portions of clean water, the soluble matter continues to be extracted for several months, even if the blocks be very small, and the tendency towards putrefaction grows less and less, but only closing after some months, and when the amount of water used has been enormous as compared with that of the wood. Finally, however, the soluble matter appears to be removed, the water then remains clear and the wood ceases to be covered with fungous growth, at least to any visible extent.

Timber, when thoroughly water-seasoned, is known to be very durable, and it is probable that it is so merely because of the removal of the soluble and putrescible albuminoids.

Experiments tried with the same woods in sea water and in brackish water (made by mixing two measures of fresh water with one of sea water) show similar sanitary results; they are even actually intensified.

The turbidity begins sooner in sea water than in fresh, in the few cases in which I have tried it, the film on the surface is more abundant, and the smell is more disgusting. The number of experiments, however, are much fewer than with fresh water.

Heart-wood and sap-wood act essentially alike in this matter, the difference is one of degree rather than of character.

The suggestiveness of these facts is almost too obvious to need comment, and yet I will add a word. Vast quantities of wood and vegetable matter, decaying in water or in swamps, are too common.

If piles about our wharves and similar structures do not smell so badly, it is merely because the solution is more dilute. The decay goes on, however, and so with vegetable matter decaying in swamps, saw-dust in ponds, and so on to the end of a long chapter. The trouble has sometimes been attributed to the obvious gases evolved, notably to light carbureted hydrogen, which one may see bubbling up with nitrogen and carbonic acid through the water of ponds where saw-dust or vegetable matter is decaying on the bottom. As I have maintained in a paper read at a previous meeting of this association, I cannot believe that either of these latter gases of decay seriously affects health. These later experiments on woods only confirm the views then expressed.

The exhalations of swamps, or of vegetable matter decaying in still water, is universally regarded as unwholesome in climates where, for a part of the year, at least, the weather is as warm as we have it. So far as I know, there is no exception to this on the whole earth, and hence the general sanitary bearing of the observations here recorded need not be further argued.

## DIAMETERS OF MARS.

IN the *American Journal of Science and Arts* for March, Professor C. A. Young, of Princeton, records the results of a series of observations undertaken by him at the opposition of Mars in November last, to determine the planet's polar compression, which, as yet, has never been satisfactorily ascertained. Sir William Herschel made it $\frac{1}{19}$, while Bessel found it insensible. The value $\frac{1}{15}$, deduced by Main at Oxford from his measures in 1862–3, has probably been of late more generally accepted than any other, though by no means without reserve. Hartig, as a result obtained by combining all the double-image measurements made at various European observatories, gives $\frac{1}{17}$. These values, however, being apparently irreconcilable with the planet's known mass and period of rotation, Professor Young, as above stated, undertook the task of measuring the diameter at its last opposition—this being an exceptionally favorable time for such a purpose. The measures were made with a filar position micrometer attached to the nine and one-half inch equatorial of the School of Science Observatory. The object-glass of this instrument (by Clark) is constructed substantially upon the Gaussian curves, and is of the highest excellence. During the past year it has shown repeatedly both of the satellites of Mars, the two outer satellites of Uranus, and the Saturnian satellite Mimas, the last being just at the limit of visibility. The final result obtained by Professor Young was a polar compression of $\frac{1}{17.6}$. The mean diameter, 20·593", resulting from these observations, when reduced to distance unity, gives 10·068"—a value sensibly identical with that obtained by Prof. Pierce from a discussion of the Washington mural circle observations, and used in the American Ephemeris.

## AMERICAN JURASSIC DINOSAURS.

IN the March number of the *American Journal of Science and Arts*, Prof. O. C. Marsh makes known some of the peculiar features in the structure of the *Stegosauria*, a suborder which includes some of the most specialized Jurassic dinosaurs known. The skull of these reptiles, so far as known, was remarkably small. In the genus *Stegosaurus*, which Prof. Marsh selects for description as a representative of the suborder, the brain was much elongated, and its most striking features were the large size of the optic lobes and the small cerebral hemispheres. The cerebrum was quite small. In comparing the proportionate size of the brain of the alligator with that of *Stegosaurus* the result proves of special interest. The absolute size of the two brain-casts is approximately as 1 to 10, while the bulk of the entire bodies was as 1 to 1,000. It follows that the brain of *Stegosaurus* was only 1-100 that of the alligator, if that of the entire weight of the body is brought into comparison. The two known species of *Stegosaurus* were about 30 feet in length. Their teeth were very numerous and mostly cylindrical in shape, and the entire dental series evidently formed a very weak dentition, adapted to a herbivorous life. The animals were probably more or less aquatic in habit. The most remarkable feature about *Stegosaurus* is the series of ossifications which formed its offensive and defensive armor. These consist of numerous spines, some of great size and power, and many bony plates, of various sizes and shapes. Some of these plates are more than three feet in diameter. The great disproportion in length between the fore and hind limbs, greater probably than in any known dinosaur, would imply that these reptiles were more or less bipedal in their movements on land. The very short, powerful fore limbs, admitting of free motion, may have been well armed with spines, and thus used most effectively in defense. The back was evidently armed as well as protected. When alive, the *Stegosaurus* must have presented, says Prof. Marsh, by far the strangest appearance of all the dinosaurs yet discovered. The remains of these animals came from the Atlantosaurus beds of the Upper Jurassic in Colorado and Wyoming.

## THE AGE OF THE GREEN MOUNTAINS.

PROF. J. D. DANA, in the new edition of his Geology, as in the preceding, referred the epoch of the Green Mountains, that is, of the folding, upturning, and crystallization of its rocks, to the close of the Lower Silurian. In the current number of the *American Journal of Science and Arts*, he presents a fuller statement of his reasons for this opinion. By the term "Green Mountains," Prof. Dana means the swell of land with its ridges, about N. 16° E. in trend, which lies between the Connecticut River on one side, and Lake Champlain and Hudson River on the other, and reaching in the south to New York island. All the rocks of the area within these limits are not referable to the range; for it is well known that the "Highland" region of Archæan rocks extends over the most of Putnam County, and the southern border of Duchess County, New York; and that rocks of the same age constitute areas to the east and north of the Highland region, in Connecticut, and also further north in Massachusetts and Vermont. These Archæan areas introduce difficulties into the geology of Western New England. After a somewhat extensive review of the evidence, Prof. Dana sums up his conclusions as follows: (1) The *western* half of the region between the Connecticut River valley and the Hudson River, that is, the western half of the Green Mountain area, is proved to consist of rocks that are of Lower Silurian age, and of one orological system. (2) The Schistose rocks of the *eastern* half in Vermont are to a large extent similar to those of the western. (3) The rocks of the central mountain section in Vermont are, in its northern part, identical schists (hydromica, etc.), with those on the

east and west sides of it. (4) The western border of the region in the Hudson River valley has its folded or upturned Hudson River (Lower Silurian) slates overlaid unconformably by Niagara and Lower Helderberg (Upper Silurian) beds. (5) The eastern border of the region in Connecticut valley at Bernardston in Massachusetts, Vernon in Vermont, and the adjoining part of New Hampshire, has Lower Helderberg beds overlying, unconformably, folded or upturned roofing slates (similar to those on the western side), the Lower Silurian age of which is not improbable; and at Littleton, in New Hampshire, and on Lake Memphremagog, in Northern Vermont, occur uncomformable Upper Helderberg (Lower Devonian) beds with fossils. (6) A very large area is required for a mountain individual of folded rocks, and it comprises all the elevations or results of upturnings, and flexure that were produced over a continuous region in one mountain-making process.

In view of these various considerations, the evidence, although not yet beyond question, is manifestly strong for embracing the whole region between the Connecticut and the Hudson rivers (and to an unascertained distance beyond) within the limits of the Green Mountain Synclinorium.

Since the slates of the Hudson River valley have, by the discoveries of Mr. Dale, been proved to belong to the Hudson River group the making of a large part, if not the whole of the Green Mountains, preceded the era of the Lower Helderberg. And the occurrence of Niagara limestone at Rondout is evidence, further, that the epoch of upturning or mountain making preceded the Niagara period, which is the first of the Upper Silurian, and hence that it occupied the time between the Lower and Upper Silurian. The occurrence of still later disturbances is proved by the folding of the Upper Silurian strata; and these, as has been suggested by Mr. Dale, may have taken place at the time of the Appalachian disturbances after the Carboniferous, and have been a consequence of the action which raised the Catskill Mountain plateau.

## A LARGE LAKE DRIED UP.

WHERE at one time, says the Eureka *Leader*, was Ruby lake there is at present not a drop of water. This sheet of water, seven or eight years ago, was from eighteen to twenty miles in length, and varied in breadth from half a mile to two or three miles, and was in a number of places very deep. It was fed by numberless springs along the foot of Ruby mountain, and was the largest body of water in Eastern Nevada. For a number of years past it has been gradually drying up, until at last it has entirely disappeared. What has been the cause of this is a mystery. The Ruby range of mountains is considered the largest and finest between the Rockies and the Sierra Nevadas, and besides being well wooded, has been the best watered range of mountains in Nevada.

## PETROLEUM IN THE OLD WORLD.

A CORRESPONDENT of the *Times* writing from Bradford, Penn., gives the following information with regard to Pennsylvania's future rivals in oil, on the authority of two gentlemen lately returned from the oil-bearing regions of Europe and Asia.

The first gentleman, the Hon. Lewis Emery, of Bradford, reports that the oil developments in Russia have been made along the Caucasus mountains, from the Caspian to the Black Sea, a distance of 1,500 miles. Oil was discovered on the eastern shore of the Black Sea in 1865, but nothing is being done there at present in the way of production. Along the Kuban river, a stream emptying into the Black Sea, a paying territory is being developed. Two wells have been sunk by a company of French capitalists, a Pennsylvania operator, the well-known Dr. Tweddle, of Pittsburg, directing the work. This company has a refinery at Taman.

The principal producing field is at the eastern end of the Caucasus range, along the Caspian Sea at Baku. It was in this region that the ancient fire-worshipers held their sacred festivals, digging pits along the sea shore, from which volumes of gas were emitted from the earth, ignited, and became the holy flame of the worshipers. Here, managed by American skill, numbers of wells have been sunk, and a daily product of 28,000 barrels of crude petroleum is obtained. Many of the wells are flowing ones, with immense capacity. They are drilled to an average depth of 300 feet, and spout their substance to the surface through 12-inch pipes. Immense quantities of sand are thrown up with the oil, and around some wells it is banked up 30 feet high and 300 feet about. Refineries of very large capacity are located at Baku, and while the same principle of refining that is used in this country is adopted there, its application is yet deficient, and the refined oil is far below the quality of refined American oil.

Owing to lack of transportation facilities, very little Russian oil is exported. Mr. Emery thinks that at present the oil trade of America has nothing to fear from the Russian field, as American oil, possessing, as it does, unlimited and comparatively cheap transportation facilities, can be placed in the markets of the world at a rate with which Russia cannot now compete.

But the development of this vast Russian field may be said to be only begun, and with the completion of railroad communication with important points it will destroy all demand for American oil in that part of the world. Oil from the Russian fields to southern markets is now carried on the backs of camels, a mode of transportation at once slow and expensive. From Poti, a Black Sea port, a railroad extends to Tiflis. This road was built by Russian capital, and its extension to the oil fields at Baku is now under way. Other transportation lines are about to be begun uniting Baku with other important seaports. To reach St. Petersburg and intermediate markets, the oil is carried on the Caspian Sea on floats from Baku to Astrakhan, at the mouth of the Volga. From that place it is taken by steamers up the Volga river to Nijni Novgorod, whence it is transported by rivers and canals to the Russian capital, a distance of 2,500 miles from the oil-wells. This costs more than to transport oil from Pennsylvania to the same Russian markets. The fuel used on these steamers is a residuum of the petroleum, which, in the Russian oil, forms about 75 per cent. of the crude, the remainder forming an illuminating oil as yet inferior to American kerosene. The petroleum fuel is eagerly sought after in the region, and is sold at 25 cents a ton. Unlike the residuum of the Pennsylvania oil, it burns without smoke. The Russian oil field may be said to be comparatively boundless. It extends down into India, where developments have been making with more or less success for some time. Oil exists in British Burmah, in Assam, and the Punjab. In the Rangoon district petroleum has been known for centuries.

The wells are attended with the same eruption of sand or mud that characterizes the Russian wells, and are called by the natives mud volcanoes. In some parts of India the crude petroleum is very thick, and becomes solid at a temperature of 60°. It is called Rangoon tar, and contains 10 per cent. of paraffine. In other parts the oil is thin, transparent, and light colored. The oil fields of Austria are situated in the Carpathian Mountains, in the primitive Province of Galicia. It covers about 500 miles of mountain territory. Mr. Emery says that, while the field may be capable of great development, it is at present yielding not more than 600 barrels a day. There are some natural oil springs in the region. The principal part of the operations is conducted by enterprising Americans, who have pushed into the isolated country—it is 400 miles north of Pesth—in the hope of developing a profitable field. The wells sunk by these men have been put down on scientific principles, but the natives content themselves with sinking a pit, the sides of which they do not shore up. The oil that exudes from the soil they collect by letting it filter over a curled-up sheepskin into the receptacle they have at hand. The oil corresponds in quality to that of Pennsylvania, and, with proper development, would yield a product far in excess of the American supply. Rude refineries are distributed through the region as far south as Bucharest, but are taxed only to supply the somewhat limited local demand. The whole region is controlled by Polish Jews, who oppose the introduction of outside capital or modern modes of operation. A peculiar formation found in connection with the Galician oil, is a wax known as ozokerit, which is extensively dealt in for the manufacture of candles.

E. M. Grant, of Foxburg, Penn., who lately returned from a visit to the Galician oil fields, gives some interesting details, the result of his observations there. The whole field is 400 miles long, he says, and 40 wide, extending from Klenezany, in the north-west, to Remairl, in the south-east, and across the Carpathian Mountains, from Szigeth, in Hungary, to Jasio, in Galicia. It is divided into the eastern, western, and Hungarian districts. The Western District produces about 400 barrels of crude oil a day in an area of territory 70 miles long and 10 wide. Operations have been carried on here in a more or less primitive way for 20 years.

Steam power has not been introduced yet, the work of engines being done by lusty and lazy Poles. The wells are put down from 500 to 800 feet, when the oil is struck. It varies in gravity and color. On one favorable spot, five acres in extent, 150 wells have been put down. The nearest railroad from Roboka, the principal oil center of the western district, is 30 miles distant. The oil is refined on the spot as it comes from the wells. Teamsters carry the oil to the railroad for 15 cents a barrel, so that, as regards cheapness of transportation, the railroad might as well be 30 miles away as on the spot. The eastern district of the Galicia oil field is at present doing very little in the way of oil production. The wells are principally centered about a place called Boryslaw. They yield from 3 to 10 barrels a day. The oil is clear, and of a deep green color. The wax deposits of Eastern Galicia are of more importance than the oil wells. This "earth-wax," or ozokerit, is the residuum of petroleum, the oil having evaporated. The wax lies in beds like clay, at depths from 350 to 600 feet below the surface. Shafts are sunk to the beds. The sides of the shafts are curbed with timbers, but in such a careless and unscientific manner that they are constantly caving in, and burying workmen in the depths. From four to six men are killed in this way every week. But the entire field is in the possession of Polish Jews of the most avaricious class. They refuse to go to the expense of making their shafts safe, and the laborers are at their mercy. Mr. Grant says that the Polish Jews of Boryslaw are hated and despised by all the Jews of Europe. The Boryslaw wax field is only 50 acres in extent, and, upon that, 10,000 shafts have been sunk On that 50 acres 12,000 men work and live. The Jews who own the deposits have made large fortunes from the product, as it is very valuable, bringing 8 cents a pound at the fields. It is used solely for making candles. The region is intensely Catholic, and "holy days" are constantly occurring, upon which occasion vast numbers of candles are used. But, besides the local demand for the wax, it requires immense quantities to supply that of other countries. The ozokerit lies in a vein 16 inches thick. It is dug out with shovels, and raised from the shafts by buckets and windlass. The owners are the only merchants, bankers, and hotel keepers in the region. Everything is mortgaged to them. The men shave their heads, leaving only a tuft of hair at each temple. The women also shave their heads, substituting mohair wigs for their natural hair.

The Hungarian oil district, while promising as well if not better than the others, has been only slightly developed. It is destined at some day to become an important region in connection with the world's supply of petroleum. The Hungarian Government offers to extend aid to any one who will begin operations looking to the development of the country.

While in Europe, Mr. Emery visited the ancient oil region in Alsace. The oil territory is nine miles long, and is owned by a Frenchman named Jacques A. Le Bel, an ancestor of whom discovered the oil in 1735. Dr. Antoine Le Bel was a naturalist, and while making investigations in Alsace in the above year he came upon a small stream of thick, oily substance exuding from the earth. By experimenting with it he found that it was an excellent lubricator. He at once began digging into the earth, believing that the oil existed in quantities beneath the surface. He sank a shaft, or rather a pit, to the depth of 50 feet, where he struck a sand rock rich with the oil. Dr. Le Bel was wealthy, and he purchased from the French Government, which then owned the land, 91,000 meters square in the region. The property has continued in the possession of the Le Bel family from that day to this, and oil operations have never ceased. During the early years of the business the rock was quarried at a depth of 50 feet, taken out in blocks, and the oil extracted from it by a boiling process. That stratum of rock was long ago exhausted, and the oil is now found at a depth of 300 feet. The system of operating adopted by the pioneer operator in 1735 is the one still used, no improvement having suggested itself to the owners of the property in the century and a half of its history, except the substitution of steam power for that of Alsacian peasants in hoisting buckets from the wells.

The sinking of an Alsacian oil well is more like the operation of opening a coal mine than of tapping the oil vein, as understood and practiced in the Pennsylvania and other American fields. When the oil operator in Alsace sets out to put down an oil well, he first erects a building 80 by 30 feet for his engine and boiler. Near by, an excavation 20 feet deep and 14 feet square is made in the ground. This is filled with solid stone masonry. Upon this foundation is erected a chimney 100 feet high, octagonal in shape, and 14 feet in diameter. The work of sinking the well is begun beneath the engine-house. As the well is to consist of a shaft and numerous drifts and galleries, its plan is first carefully laid out by an experienced engineer. The shaft is excavated entirely by workmen with the pick and shovel. The work goes on night and day, there being three sets of hands, three in a set, who work eight hours each. The shaft is 14 feet in length, and 6 feet wide. When it reaches a depth from which it is impossible to throw the dirt out with the shovels, a windlass with buckets attached is put in position, connected with the engine, and the dirt is then raised by them. These buckets have bottoms hung on hinges. When one is hoisted up, it is swung around over a small car and dumped. The car is trundled away by laborers, and in turn dumped on the outside of the building.

From the time the engine starts, 17 men are engaged in the sinking of the well. The shaftmen, at all depths, receive 55 cents a day. The engineer, firemen, tubmen, and carmen receive 40 cents a day, and work 12 hours. The pay roll of these 17 men is $9 05 a day—a sum two workmen in the Pennsylvania oil regions would think small enough to divide between them for a day's work at a well. As the shaft is sunk the walls are curbed with strong timbers in a secure and workmanlike manner. The average depth of a shaft when it reaches the oil-bearing sand is 300 feet. At the depth of 30 feet a drift is cut from the shaft at an angle that will bring its upper opening to the base of the stack or chimney mentioned, an opening in which, at that spot, makes of the drift and chimney an exit for the impure air of the shaft, the draught being sufficient to exhaust all the poisonous gases. The shaft is divided into three compartments, which are numbered 1, 2, and 3. No. 1 is 8 by 6 feet, and is the "well." No. 2 is 3 by 6 feet, and is made air-tight at the top. This is the compartment up which the impure air is drawn by the drift and the chimney. No. 3 is also 3 by 6 feet, and is the shaft that gives to the workmen below the fresh air that enables them to carry on their arduous labor. The ventilation by this arrangement is said to be so perfect that there is no record of a death from suffocation having ever occurred among the workmen. Indeed for a period of 30 years the death rate at these wells has been marvelously low, only seven men having been killed in that time.

Every one of these met his death by falling from the long ladders by which the miners go and come from their work in the fresh air shaft. When the well has reached the oil sand, and penetrated it to a sufficient depth galleries are opened in various directions, with a slightly ascending grade. These galleries extend long distances in the surrounding stratum, and drain an area of several acres of its oil. The oil drips into the galleries, by which it is conducted to the bottom of the main shaft. There it is dipped up by the miners, poured into buckets—the same that raised the dirt and *débris*, from the shaft—which, when full, are hoisted to the surface and taken to the refinery. The miners—for they can be called nothing else—are lighted at their work by Davy lamps, which they strap to their breasts. Fortunately for these workmen and for their employer this Alsacian oil produces no gas like the American petroleum, or an entirely different system of operating would be necessary.

To sink one of these wells to the depth of 300 feet occupies seven months, and costs, including machinery, $14,000—about four times the cost of a "hole" in Pennsylvania. No water is encountered at that depth, but in attempting to sink one of the old shafts to another supposed stratum of oil-bearing rock, the workmen struck a vein of salt water, which drove them from the well. Having no pumping apparatus, the water was being taken out by means of the buckets when Mr. Emery visited the well, and it was expected that it would all be taken out in a week—a twenty-four hours' job with American machinery. Mr. Le Bel was incredulous when told how the American wells were operated, although Mr. Emery believes that the Alsatian oil is too thick and the rock too close to be worked by the Pennsylvania process. The refinery is primitive and rude, but Le Bel succeeds in getting 60 per cent. of good lubricating oil, no illuminating being obtained. The oil is sold by the pound, or, rather, in packages of 200 pounds, called kilos. The price received is from $6 to $10 a kilo, according to grade, equal to what would be from $5 to $8 a barrel in this country. Two wells that were in operation when Mr. Emery was in Alsace were producing 12 tons of oil a day.

## THE NARCOTIC OF THE AUSTRALIANS.

IT is a marvelous circumstance that the black man of Central Australia should have dropped upon the same narcotic principle (nicotine) as the red man of America. The forest is the home of the native, and there the white man often feels his own inferiority, as the native often puts himself on a meal under circumstances where the white man would starve. As a hunter the black man is perfection itself. These remarks occur in a paper read recently before the Queensland Philosophical Society by Dr. Bancroft, who there adds materially to our information concerning the "pituri" or "pitch'ery" of Central Australia. Pituri is a plant not far removed from the tobacco plant which grows in Central Australia. The leaves of the plant are chewed by the aborigines, who trade with it far and wide. The plant yielding it has been determined by Baron von Mueler to be the *Anthocercis* or *Duboisia Hopwoodii*. Chemical analysis shows that the alkaloid in which the peculiar poisonous properties depend, is nicotine, the same substance to which tobacco owes its effects. Pituri causes extreme contraction of the eye balls. It is much sought after by the natives, who will give anything they possess for it, not for the purpose of exciting their courage, or of working them up to a fighting pitch, but to produce a voluptuous dreamy sensation, such as is experienced by the opium eater. The natives in some districts are said never to travel without it on their long marches, using it constantly to deaden the cravings of hunger and to support them under excessive fatigue. King, the survivor of the Burke and Wills expedition, who had lived seven months with these natives when rescued by Howitt, states that when his food became so scarce and bad as barely to support life, he sometimes obtained a chew of pituri, which soon caused him to forget his hunger and the miseries of his position. It also plays an important part in the social rites of these natives. At their big talks and feasts the pituri quid is ceremoniously passed from mouth to mouth, each member of the tribe having a chew, from the "pinaroo" man or head-man downwards. This singular wassail cup never fails to promote mirth and good fellowship, or to loosen the tongues of the eloquent.

## GEODESIC AND ASTRONOMIC CONNECTION OF ALGERIA WITH SPAIN.*

THE possibility of connecting Algeria with Spain above the Mediterranean was looked at almost as a dream seventy-one years ago by Biot and Arago; but later on, in 1863, Colonel Levret proved by calculation that the trajectory of the visual rays proceeding from Algeria to Spain, from the summits of the Atlas to the Sierras of Granada and Murcia, is not intercepted by the curve of the earth, and that the junction of the two countries is possible, notwithstanding the enormous distance which separates them. But between the results of these calculations and the facts of the case there was reason to fear that there was room for impossibility. The reconnoissance which I made upon the very

FIG. 1.—GEODESIC STATION AT M'SABIHA, NEAR ORAN, ALGERIA.

spot in 1868, however, made the matter entirely certain. I made known the results of this reconnoissance in a memoir read before the Academie des Sciences, November 18, 1872. The crests of the Spanish Sierras are visible to the naked eye, in favorable weather, from all geodesic points of the first class, comprised between Oran and the frontier of Morocco. On examining the principal summits of these jagged crests, I ascertained that two of them had a very characteristic form and were always visible, and might thus furnish a base for crossing from Spain to Algeria by means of immense triangles exceeding in length any that had ever before been attempted. I even indicated the names of the apices of the triangles possible, calculated the approximate lengths of the sides, and then proposed to have recourse to the use of solar light by day and electric light by night, in order to obtain signals which should be visible at distances close on 185 miles.

It was not till 1873, after a preliminary understanding between the Spanish and French governments, that General

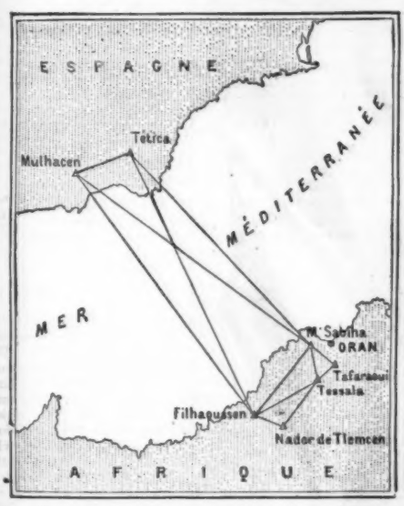



FIG. 2.—GEODESIC JUNCTION OF SPAIN AND ALGERIA.—MAP OF THE QUADRILATERAL ADOPTED.

Ibañez and myself were commissioned to take the measures necessary for making definite observations between Spain and Algeria. Among all the summits possible, we chose, in Spain, the Mulhacen—the culminating point of the Sierra Nevada, 11,664 feet high; in the province of Murcia, the Tetica, 6,825 feet high; in Algeria, the Filhaoussen, culminating points of Traras, between Tlemcen and Nemours, and the M'Sabiha, near Oran, respectively situated 3,700 and 1,800 feet above the level of the sea (Figure 2). These four points form a magnificent quadrilateral whose four summits are visible from each other. As the Mulhacen is accessible and habitable only during the quite short period during which it is free from its snows, and as observations can only be taken in Algeria towards the end of summer, we were hardly able to do any definite work of this kind except during the month of September. In order to finish our operations in one campaign, we decided, with Gen. Ibañez, that the four stations should be occupied simultaneously; in Spain, by Spanish officers, and in Algeria, by French officers, selected from among the ablest observers, and provided with instruments exactly alike, and to make observations

* By Commandant Perrier of the Acad. des Sciences.

according to one method in common. As such operations had never before been performed at like distances, and the processes used up to that time for making signals might not prove effective, prudence required us to have recourse to new apparatus. Gen. Ibañez desired that I should be allowed to choose them, and have them constructed in Paris. For the solar signals, I ordered of M. Breguet special heliostats, the plane silvered mirrors of which were 10·8 inches square. For the electrical signals I adopted a reflector which was specially constructed for us by Col. Mangin, of silvered glass 19·7 inches in diameter and 23·6 inches focal distance. In order to obtain as great intensity as possible, I adopted, as a source of electric light, a Gramme machine actuated by a steam motor, and causing the production of a voltaic arc between the two poles of a Serrin's regulating lamp, at the very foci of the projecting apparatus. These apparatus being ready, the officers came to Paris to study and obtain those which were designed for them, and all of us together made photometric experiments day and night in the shops of MM. Breguet and Santter, in order to ascertain the power of our instruments. The results exceeded all our hopes, the effect produced being equal to that of several thousand Carcel burners. All of our material being thus prepared, it became necessary, in order to transport it to the summits of the quadrilateral, to open new routes through steep and nearly inaccessible regions; and in this labor several hundred soldiers were employed for a number of months both in Algeria and Spain. It was also necessary to provide reservoirs to insure of a supply of water, and depots for coal for the engine. All preliminary operations concluded, the four stations were ready on the 20th of August, and each one was at his post—Col. Barraquer at Mulhacen, Major Lopez at Tetica, Capt. Bassot at Filhaoussen, and I at the station M'Sabiha. The weather was fine, but the mists which arose from the Mediterranean would not allow of the passage through them of the solar rays directed on our instruments; and at night the electric signals could not be seen either. Let me say here that the solar signals were a complete failure; not a single one was seen, either in Spain or Algeria. We would have experienced an entire and disastrous defeat had we not had recourse to the electric light. Finally, on the 9th of September, after a feverish anxiety, I perceived the Tetica light, visible at times to the naked eye as a reddish disk of uniform tint, and as to brilliancy comparable with the star Alpha of Bootes, which was then visible in the vicinity above the horizon of the sea. On the 10th I perceived the Mulhacen light; and our Spanish colleagues at the same time recognized our signals, and we then entered upon a series of definite observations, which, beginning on the 9th, were finished on the 1st of October. The degree of precision of our measurements is evinced by the minuteness of the errors of the four triangles which form our connecting quadrilateral. These errors, which are still susceptible of corrections (although very slight ones), are equal, in seconds of an arc, to

$$+0{\cdot}18'' - 0{\cdot}54 + 1{\cdot}84'' + 1{\cdot}12''$$

and do not exceed, as may be seen, the errors of this kind that are met with in the best triangulations where the sides do not go beyond 18 to 30 miles. The problem of the geodesic junction of the two continents is thus resolved, and the meridian of France extends uninterruptedly to-day from the Shetland Islands to the Sahara.

The first result in question once obtained, our task was not yet complete; for we had also proposed to project on the sky two of the points of our quadrilateral—one, M'Sabiha, situated in Algeria, and the other, Tetica, in Spain. The object was to measure at these two stations the latitude and an azimuth, as well as the differences in longitude between Algiers and M'Sabiha, in order to connect the latter with Paris, and between M'Sabiha and Tetica to connect us with Madrid. The astronomer Merino, with Engineer Esteban, occupied the station Tetica, Capt. Bassot that of Algiers, while I, with Capt. Defforges, continued observations at M'Sabiha. The three observers were provided with meridian circles, and with apparatus exactly alike. The station M'Sabiha being connected by telegraph with that of Algiers, the difference in longitude of the two stations was obtained by an exchange of the local hours by means of telegraphic signals registered on the chronographs of the two stations. To compare the clocks of Tetica and M'Sabiha with each other, we had recourse to a reciprocal exchange, over the Mediterranean, of luminous and rhythmed electrical signals, the transmission of which, even to a distance of 200 miles, may be considered as instantaneous.

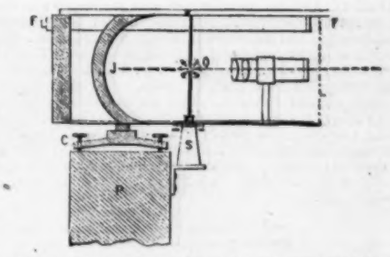



FIG. 4.—DETAILS OF AN ELECTRIC LIGHT PROJECTOR.

P. Pillar of dressed stone. C. Tripod, with leveling screws. J. Glass mirror silvered on the back and with curves so calculated as to prevent spherical aberration. O. Focus of the mirror, where is directed the electric light furnished by the Serrin lamp. F F. Telescope.

In this case, the personal equation of the two observers is double; it not only comprehends that which relates to the observation of the stars, but also that which results from the observation of the instantaneous luminous phenomena; and it was necessary to determine each of these equations carefully. To this end, M. Merino came to Paris during the months of June and July. The first equation was determined by the usual method, in our pavilion of longitudes at Montsouris, and the second at the Paris Observatory, in the following manner:

A Mangin collimator was placed on the tower of Montlhery, and directed on the platform of the Observatory. M. Merino and I separately observed the luminous signals made at Montlhery, with telescopes exactly alike, and each signal registered itself on the band of a chronograph provided with three pens, one of which marked the hour of the clock, and the other two the instants of the phenomenon for each observer. We made these observations on forty signals; and then, to reverse all the conditions of the experiment, and to eliminate the parallax of the pens, we changed telescopes and proceeded to make a new series of observations of forty signals. These two series together gave us a value of the personal equation relative to the signals. We took observations thus for more than a month on several thousand signals. These preliminary experiments showed us that, as pointed out by M. Lials, the observation of rhythmed signals gives very precise results; but they have also revealed to us some new facts which contradict certain conclusions of that savant. For instance, the personal equation is not null in the observation of rhythmed signals; every observer has his own. It is, it is true, less variable, during a same evening, or from one evening to another, than that which manifests itself in observing the passages of the stars; but it may, like the latter, reach one or several tenths of a second. Between M. Merino and me it rises to 0·124. All the values obtained are comprised between 0·108 and 0·149, which proves how little important to us were the variations due to the physiological state of the observers. In the second place, it is preferable to observe the instantaneous eclipses and not the apparitions. In our experiments it was possible to observe either, but the observation of the eclipses is more precise and more sure. Physiologists may explain this fact; but I attribute it to this especially, that even with the rhythmed signals, the apparition of a signal always causes a certain surprise to the observer. Finally, the rhythm which is most convenient, is obtained by spacing the eclipses from two to two seconds, the duration of the eclipses and that of the apparitions being the same, and equal to a second of

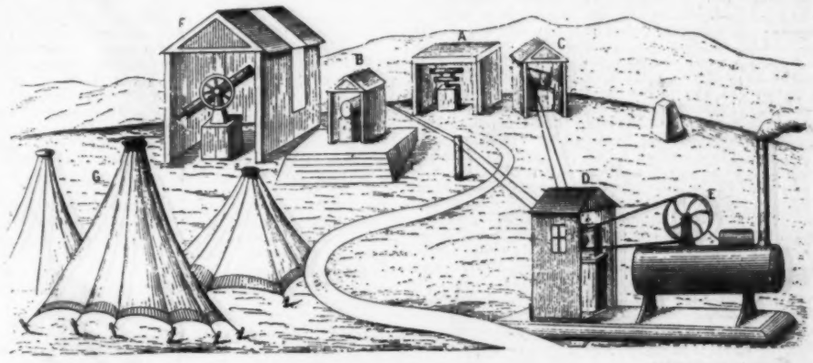



FIG. 3.—STATION AT M'SABIHA.

A. Central Pillar. Repeating Azimuthal Circle. B. Light Projector, directed on Tetica, Spain. C. Projector directed on Mulhacen, Spain. D. Gramme Machine. E. Three-horse Power Engine. F. Meridian Room containing the Meridian Circle. G. Tents for Shelter and Storage.

time. The exchange of luminous signals between Tetica and M'Sabiha, at the distance of 168 miles, certainly could not have been effected, had not the rays, which were well directed and of constant intensity, been susceptible of being interrupted instantaneously. To realize the latter conditions, which were unnecessary in the azimuthal measurements, we used our optical collimators or refractors with lenses, substituting for the usual petroleum lamp an electric one—not of the Serrin model, but an electric hand-lamp, which could be regulated continuously. These little apparatus can be regulated and arranged like telescopes; they are easier to manage than reflectors, and give images which are almost as sharp, although the lenses are only 8 inches in diameter. I estimate the distance at which they can be perceived in favorable weather with a 4-inch telescope at from 300 to 375 miles. They also present this great advantage, that when a conjugate image of the positive carbon forms in the focus of the lens in the shape of a small disk ¼ inch in diameter, the luminous ray may be almost instantaneously interrupted by a small lever under the intermittent action of an electro-magnetic apparatus. The exchanges of signals were effected as follows:

Tetica, for example, sent forty signals; and at the moment of each eclipse the lever of the cap closed the current of the local battery, and the phenomenon was registered automatically on the chronograph. M'Sabiha, on its part, observed the moments of the eclipses and also registered them. Then M'Sabiha sent and registered forty signals, which Tetica received and registered the same way. Each complete exchange comprised four parallel series, or in all, a hundred and sixty signals received. Two exchanges per evening gave a registry on the part of both of 640 signals, divided into eight series. The effect produced by the rhythmed appearance and disappearance of the little luminous disk was very marked; so much so that we would have been able in the majority of the evenings to observe the eclipses with the naked eye. However, we always compelled ourselves to use the telescope so as not to modify the physical conditions under which we had determined our personal equation. From the 5th of October to the 16th of November, we reciprocally perceived our electric signals during fifteen evenings; seven of them only, equally favorable to M'Sabiha and Tetica, can serve for calculating longitude, each comprising, from all quarters, at least four circumpolars, with fifty horary stars distributed in four successive positions of the circle, and the exchange of six hundred and forty signals.

This is the first time that an operation of this kind has been performed, and it has been crowned with entire success. We have thus closed the vast polygon of longitudes, one of whose angles is at Paris, and the others at Marseilles, Algiers, M'Sabiha, Tetica, and Madrid. This exceptional polygon contains all the possible cases which can arise in the measurements of longitudes, since it comprises in its perimeter aerial wires, a submarine cable, and, in lieu of a wire, a sort of luminous track which unites M'Sabiha with Tetica over the Mediterranean.

## IMPROVEMENT IN MICROSCOPIC EYE-PIECES.

By J. H. WYTHE, M.D.

THE magnifying power of microscopic objectives depends on the diameter of the cone of rays at the upper part of the tube of the instrument. The cone of rays from an objective of short focal length is much wider at the base than the cone from one whose focal length is larger.

The diameter of such a cone may be increased by using a concave lens, or meniscus, which produces still greater divergence.

If this diverging lens be made achromatic, no injurious effect can happen to the image formed by the objective, save the loss of light consequent on enlargement. Even a non-achromatic concave lens or meniscus may be usefully employed to amplify the image, so that an objective of low power may be made to magnify an object as much as one of shorter focal length. Theoretically, a perfectly achromatic amplifier is needed, but practically, one not achromatic is quite useful. The degree of amplification depends on the concavity of the amplifier, its nearness to the objective, the length of the tube, and the power of the eye-piece used to concentrate and magnify again the image produced.

The diameter of the microscope tube has an important relation to the distinctness and luminosity of the image. Few tubes are wide enough to utilize more than a small proportion of the rays proceeding from an objective. The field glass of the eye-piece should be of the greatest diameter possible for its focal length, and the tube wide enough to receive it, in order to concentrate the greatest number of rays from the objective. The short tubes of French and German microscopes are supplied with narrow eye-pieces, which cut the cone of rays nearer the objective and give a more brilliant image than would be possible in a longer tube. If the tube be longer, it must also be wider, and the eye-piece of corresponding diameter.

In considering the construction of the microscope with a view to greater amplification by the eye-piece, it occurred to me that the concave lens or meniscus used to diverge the rays of the objective should form a part of the eye-piece and be of as large diameter as the tube will allow. If it be of small diameter, it must be placed near the objective. This is the form and position of the amplifiers of Tolles, Zentmayer, and others.

One of the amplifiers, exhibited by me to the San Francisco Microscopical Society on a previous occasion, consists of a conical meniscus, whose position in the tube and effects correspond with the amplifiers above named. With this simple addition placed in the lower end of the draw tube, the magnifying power of an objective can be nearly doubled with little loss of light or of definition.

### THE OTHER FORM OF AMPLIFIER

exhibited is still better. A double concave lens, or meniscus, of as great diameter as the tube will allow and of considerable diverging power, is placed at a distance of from two to four inches in front of the eye-piece. In the improved form in which I now present it, a concave meniscus of six inches equivalent focus and one and a half inches diameter (which formerly served as part of the object-glass of a small telescope), is placed in a draw-tube at the end next the eye-piece and about three inches from the latter. To counteract the aberration of the amplifier, I have sometimes substituted for the plano-convex field glass of the Huygenian eye-piece a convex meniscus of short focus, which gives also a very wide and flat field of view. Ordinary eye-pieces and the periscopic eye-pieces of Gundlach may also be used with the amplifier. The amplifying eye-piece, thus constructed, has given me great satisfaction. If the concave meniscus were made achromatic, it would doubtless be a still further improvement, yet the performance of the eye-piece leaves little to be desired. The wavy, basket-like, longitudinal striæ on *Surirella gemma* and the hexagons on *P. angulatum* are well seen with a one-fourth objective, and the *Frustula Saxonica* and *A. pellucida* (dry) have been resolved by it with a non-adjusting one-eighth of Gundlach's.

### IN PLACE OF THE CONCAVE MENISCUS

referred to, I have also used, with nearly as good effects, a double concave lens of two or three inches equivalent focus, such as can be obtained at an opticians for about 50 cents. So that by a very small cost of time and money, the possessor of an ordinary objective may increase the power of his instrument to a very great degree.

I reiterate the conviction before expressed, that further improvement of the microscope may be looked for in the construction of eye-pieces—regulating their magnifying power and increasing their diameter so as to concentrate rays from the objective, which are now absorbed by the sides of the tube.—*Mining and Scientific Press.*

## VIBRATORY MOTION IN FLUIDS.

A PAPER was lately read by Mr. Ridout, before the London Physical Society, on "Some Effects of Vibratory Motion in Fluids." It was found by Savart and Tyndall that jets of water were sensitive to notes, or air vibrations, like flames, and the author conceived the idea of vibrating the jet of water from within. To do this he caused an electro-magnetic arrangement to pinch the tube conveying the water 400 to 500 times per second so as to communicate a vibratory motion to the stream of fluid. The issuing jet spread out in two streams, beautifully broken into drops, and representing the fundamental note. When the pinching lever vibrated irregularly, harmonics were observed. When the water was thrown into vibration in two different planes the resulting jet rotated in the tube. Froude's deduction that a liquid moving in a tortuous tube has a tendency to straighten the tube was illustrated by oscillating a pipette with its nozzle in a vessel of water, and filling a colored liquid into it, which is seen to flow from the nozzle through the water in a tortuous line. By giving the pipette also a motion round its axis the line becomes a spiral; a sounding body produces no disturbance in the stream. The author also showed that the cardboard experiment of M. Clement Desormes can be extended to water. In this experiment a card is attracted to another card by blowing a jet of air through the latter upon the surface of the former. Mr. Ridout allows a jet of water to flow out of a glass tube with a cup-shaped mouth upon the surface of a glass ball, and when the ball is within a certain distance of the mouth it is attracted towards the latter and sticks in the mouth. In explanation of this fact it was shown that the ball and cup remained in such a position that the outflow of water was greater than if the globe had been entirely absent.

## DOES THE COCOON PRESERVE THE CHRYSALIS FROM THE COLD?

ALMOST all larvæ which are about making preparation to undergo a metamorphosis need to seek a retreat where they may shelter themselves during this period of their life. They are, in fact, exposed while in the nymph state to enemies of all kinds, and are without defense. Some bury themselves in the earth, others retire to fissures in walls and barks, and a large number surround themselves with that silky envelope which is so remarkable in the mulberry bombyx, and which is called a cocoon. It would be difficult to say why all nymphs do not spin cocoons, but those which have well-developed ones usually belong to species having aerial chrysalides whose nymphation takes place under very diverse atmospheric influences. It is natural to ask, then, whether the cocoon, which forms a protecting covering, designed for hiding the nymph from the sight of birds (which are very fond of it as food), and for affording a quiet retreat to the insect, also shelter it from the inclemencies of the weather, and allows it to pass the winter without being reached by the cold of our climate, and which is very often severe. I will not go into any details as to how the cocoon is hidden from sight, either in some cleft, under the edge of some stone, or in the fork of some branch; since such facts are stated in all the books. Darwin has shown how the color of the cocoon is often correlated with that of the object to which it is attached; but this principle, however, should not be carried too far, for quite a large number of cocoons are white or yellow, which are colors that oftenest contrast with that of surrounding objects. The point that I wish to examine in this note is, what utility this covering may possess in protecting the nymph from variations of

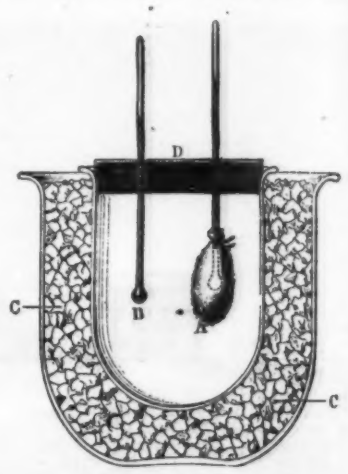



FIG. 2.

A. Thermometer inserted in a Cocoon. B. Comparative thermometer. C. Freezing mixture. D. Cork Stopper.

temperature. Every one knows that silk is quite a poor conductor, and the observations which I am about to record might possibly lead us to think that the cocoons form a sort of chamber in which the nymph, owing to this slight conductivity, retains a temperature much higher than that of the surrounding medium, and by preserving its caloric, is able to cope with the inclemencies of winter, however severe it be. The caterpillar of the ailantus silkworm (*Attacus cynthia*) at the end of autumn spins a dirty-gray ovoid cocoon, which it suspends by a solid cable two to three centimeters long beneath a small branch; and in such a way that the nymph, surrounded by its silky covering, hangs in the air free from the branches, and under excellent conditions for undergoing all the variations of the temperatures (Fig. 1). Every one will remember the intensely cold weather that prevailed at Paris during the month of December, 1871. From the 8th to the 19th of that month the mean temperature remained at —9°, and on the 21st the mercury went down to —20°, and stood at —18° for 24 hours. The winter being over, and the month of March having come, upon looking at the leafing trees of the abbatial mansion of Saint Germain-des-Prés, where I was living at the time, and

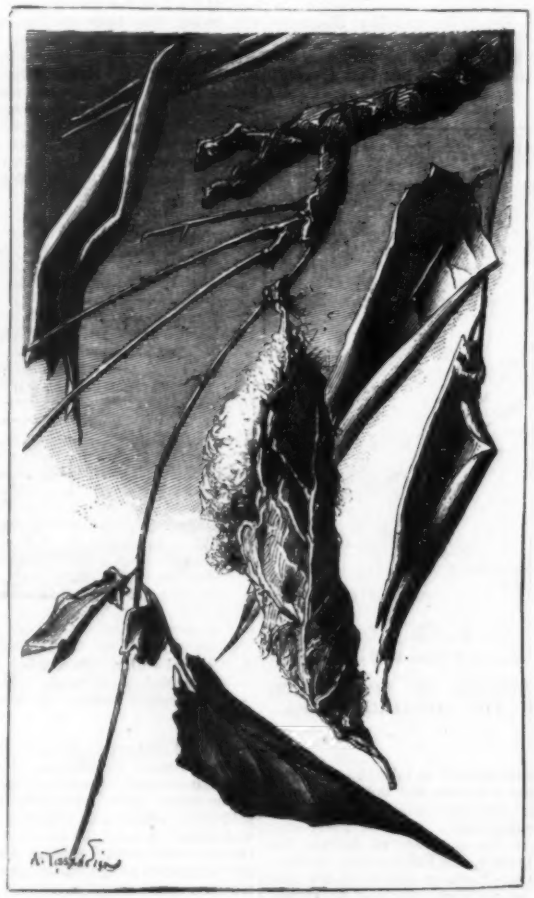


FIG. 1.—COCOON OF *ATTACUS CYNTHIA* SUSPENDED FROM A PETIOLE OF AILANTUS.

the garden of which was planted with ailantuses, I perceived hanging from the branches a certain number of cocoons of the *Attacus cynthia*, which I had not before remarked. I then learned that Babinet, who had occupied this house towards 1860, had devoted his time to experiments in acclimating the ailantus silkworm in this same garden. These cocoons came from that source, and from 1860 to 1871, the generations had succeeded each other in the open air without any one troubling himself about them, and had been obliged to endure the cold of eleven winters. But the last season was of such a nature that it did not allow of a longer duration to this attempt at acclimatization. I gathered then some forty of these cocoons, and found to my surprise that they were in a perfect state of preservation. With the exception of a few which had become black from the decomposition of the nymphs, they had kept their gray color, their size and their weight, and contained nymphs in a perfect state of health, and ready to hatch out. A dozen of these cocoons were put aside in a paste-board box, and on the 25th of March there began to issue forth those magnificent moths which everybody admires. What is remarkable in the fact that I have just stated, is the unexpected resistance offered by the nymphs to freezing. It would be impossible to assign such a resistance but to two causes: either the nearly absolute lack of conductivity of the silky envelope, or the production of a remarkable quantity of heat on the part of the insect. Experiment alone, however, could resolve the problem, and decide it in favor of one or the other of the two suppositions. It was quite easy to ascertain first the degree of conductivity of the cocoon, and it was from this standpoint that I sought to obtain light on the question. After opening the end of a large cocoon and removing the chrysalis, I introduced therein the bulb of a very sensitive thermometer; then with a rubber band I gathered the edges of the aperture around the tube of the thermometer in such a manner as to cut off all communication with the surrounding air. The bulb of the thermometer was not allowed to touch the cocoon at any point. The cocoon thus prepared was introduced, along with a comparative thermometer, into a vessel surrounded by a freezing mixture (Fig. 2). Before the experiment, both thermometers stood at 18°. Five minutes after their introduction into the vessel they were withdrawn. They both marked 9°. They were then hung up in the open air. The mercury in the free thermometer rose rapidly; that in the one inclosed in the cocoon began in a minute to rise perceptibly, and ten minutes afterwards stood the same as its companion, which in a short time had regained its first level of 18°. The experiment demonstrates, then, that the cocoon offers no protection to the insect as regards temperature; but, at the same time, it teaches us an unexpected fact, and that is, if the nymph resists freezing, it does so by virtue of a considerable and continuous disengagement of heat. How is this production of heat accomplished, and at the expense of what? It is extremely probable that it is at the expense of those organic transformations which take place in the interior of the nymph. In fact, these modifications are so great that certain naturalists have gone so far as to claim that all the organs are destroyed, to be reconstructed on a new plan. This opinion is probably too sweeping, but it is true, nevertheless, to speak of the muscular system only, that certain muscles which are used by the larva disappear, and that there is a formation of new ones which will be used by the perfect insect. An operation of this kind could not be effected without a reciprocal setting free and consumption of heat, which would counterbalance each other if the reconstructed muscles were equal to those destroyed. But the muscular system of the larva is much more extensive than that of the perfect insect; and all of the heat that has become disposable through the destruction of the old muscles is, then, not utilized in the construction of the new ones. Moreover, uric acid and its derivatives are found in abundance in the newly metamorphosed insect, and this is another proof of the existence of active combustion during the period of nymphation. According to all appearances, then, it is to these organico-chemical phenomena that must be attributed the facility with which insects in the course of transformation support prolonged depressions of temperature.—*Dr. Jousset de Bellesme, in La Nature.*

## BIRD ARCHITECTURE.

### THE RHIPIDURA AND ITS NEST.

THE bird represented in the accompanying engraving is a fly-catcher belonging to the genus *Rhipidura*, which embraces about fifty species, all characterized by elongated tail feathers capable of being spread out in the form of a fan. These large feathers, called in the language of ornithology *rectrices*, often have, in the genus under consideration, a pure white shaft which forms a marked contrast with the dark color of the vane. The colors of the plumage are almost always modest, but sometimes very prettily distributed, the forehead being ornamented with a red band, or the white of the underpart of the body being diversified by a broad belt of some other color, which gradually merges into that of the back and wings. All have large flattened bills, slightly hooked at the extremity and provided with rough hairs along the margin, and which are probably designed for holding between the mandibles such flies and other insects as the bird may capture in its flight. Europe, Africa, and Northern Asia, which are rich in fly-catchers of varied forms and colors, possess no *Rhipiduræ*, these birds being confined to Southern India and Indo-China, Malasia, Australia, New Zealand, and most of the islands of Oceanica. The species figured in the plate, *R. albiscapa*, is distributed throughout the whole Australian continent and Van Diemen's Land. It is represented in New Zealand by a form which is so closely allied that it might almost be called a variety simply. The shades of plumage of the *R. albiscapa* vary slightly according to locality, but the colors themselves always remain the same, being a dark sooty brown on the back and breast; white on the throat, over the eye, on the edges of the secondary feathers and wing coverts, on the shafts, and at the extremities of all the rectrices except the two middle ones; and tawny at the abdominal region. The eyes, bill, and legs are of a blackish-brown. The total length of the bird is not much over five inches. The nest, which is composed of shreds torn from the bark of the eucalyptus and bound together with spiders' webs, is about two to three inches in diameter by four to five inches high. The female lays but two eggs, which are white spotted with olive-brown. The young are scarcely distinguishable, except in size, from the parent birds. The birds never quit Australia; but simply seek another part of the island at the approach of winter, selecting spots sheltered from the icy winds blowing from the south-west. Toward the month of October they busy themselves with the construction of their nests, and during the following three months often raise two or three broods.

[Continued from SUPPLEMENT No. 221, page 3519.]

## FOREST TREES OF NORTH AMERICA.

By CHARLES S. SARGENT, Arnold Professor of Arboriculture in Harvard College, Special Agent Tenth Census.

### RHAMNACEÆ.

32. *Zizyphus obtusifolius*, Gray. *Paliurus Texensis*, Scheele.—New Braunfels, Texas, to New Mexico. A small tree or shrub.

33. *Condalia obovata*, Hook. Icon., t. 28. (Blue Wood. Log Wood.)—Common in Eastern Texas, Western Texas, and Southern New Mexico. A small tree.

34. *Rhamnus Caroliniana*, Walt. *Frangula Caroliniana*, Gray.—Queens County, New York, south to Florida; west to the Rocky Mountains and Western Texas. A small tree, or more commonly a shrub.

35. *Rhamnus purshiana*, D. C. *Frangula purshiana*, Cooper. (Bear Berry.)—Mendocino County, California, north to Puget Sound. A small tree, sometimes 20 feet in height.

## BIRD ARCHITECTURE.

36.—*Ceanothus spinosus*, Nutt. (Red Wood.)—California, in the coast ranges, from Santa Barbara to Los Angeles. A small tree.

37. *Ceanothus thyrsiflorus*, Eschscholtz. (California Lilac.) California, in the coast ranges, from Monterey to Humboldt county. A small tree.

### SAPINDACEÆ.

38. *Æsculus Californica*, Nutt.—California, from Mendocino County and Mount Shasta, south to San Luis Obispo, and east to the foot-hills of the Sierra Nevada. Wood "soft and brittle." A small tree, or more often a wide-spreading shrub.

39. *Æsculus flava*, Ait. *Pavia flava*, Moench. *Æ. sargenta?* Buckley, Proc. Acad. Phil. 1860, 443. (Sweet Buckeye.)—Mountains of Virginia, southward along the Alleghany Mountains to Georgia and Northern Alabama; westward to Jefferson County, Indiana, and the Indian Territory; most common west of the Alleghany Mountains. A tree sometimes 60 feet in height, with a trunk 2 to 3 feet in diameter.

40. *Æsculus glabra*, Willd. *Æ. Ohioensis*, Mich. f. (Fetid Buckeye. Ohio Buckeye.) Western Pennsylvania, Virginia, and Tennessee, and west to Western Missouri. A small or medium-sized tree; along streams.

41. *Ungnadia speciosa*, Endl.—Texas and Eastern New Mexico. A small tree, or often a shrub.

43. *Sapindus marginatus*, Willd. (Soap Berry.) Georgia to Southern Florida, near the coast; west to Arkansas, Texas, Southern New Mexico, Arizona, and in Sonora. A small tree.

43. *Sapindus saponaria*, L. (Soap Berry.) Southern Florida, and through the West Indies. A small tree; the fruit rich in saponin, and used in the West Indies as a substitute for soap.

44. *Hypelate paniculata*, Cambess. *Melicocca paniculata*, Juss. (Madeira Wood. Honey Berry. Genip Tree.)—Southern Florida, and through the West Indies. A small tree.

45. *Hypelate trifoliata*. Swartz. Southern Florida and through the West Indies.

46. *Acer circinatum*, Pursh. (Vine Maple.) Northern California to Puget Sound. "Wood fine, white, close-grained, very tough, and susceptible of a good polish." A tree 30 to 40 feet in height, or sometimes a shrub forming impenetrable thickets along streams, the vine-like stems taking root wherever they touch the ground.

47. *Acer dasycarpum*, Ehrh. *A. eriocarpum*, Michx. (White Maple. Silver Maple.) Northern Vermont, south to Florida; west to Minnesota. Eastern Nebraska, and the Indian Territory; most common west of the Alleghany Mountains. Wood soft, white; of little value. A large tree, 60 to 80 feet in height, with a trunk 6 to 8 feet in diameter; along streams. Maple sugar is occasionally manufactured from the sap of this species.

48. *Acer grandidentatum*, Nutt.—Head waters of the Columbia River, cañons of the Wasatch Mountains, and South-

ern Utah to Ash Creek, Arizona. Wood resembling that of the Sugar Maple. A small tree.

49. *Acer macrophyllum*, Pursh.—Santa Barbara, California, to latitude 5?° north. In California, in the coast ranges, and on the western slope of the Sierras; in Oregon and Washington Territory, west into the Cascade Mountains. Wood valuable, hard, close-grained, susceptible of a good polish; the best substitute in the Pacific forests for eastern hickory. A tree 80 to 100 feet in height, with a trunk sometimes 5 feet in diameter; in California much smaller. From the inner bark mats, hats, and baskets of excellent quality are made; maple sugar is manufactured from the sap of this species.

50. *Acer Pennsylvanicum*, L. *A. striatum*, DuRoi. (Striped Maple. Moose Wood. Striped Dogwood.) Lake Saint John, latitude 47° N. (Michaux); southward throughout New England and along the Alleghany Mountains to Northern Georgia, and west along the northern boundary of the United States to Wisconsin. Wood white, close-grained, very hard. A tree 20 to 30 feet in height, with a trunk 6 to 8 inches in diameter.

51. *Acer rubrum*, L. *A. Drummondii*, Hook and Arn. (Red Maple. Swamp Maple.) Latitude 47° N. (Michaux); southward to Florida; west to Minnesota, Eastern Nebraska, the Indian Territory, and Eastern Texas. Wood whitish or rose-colored, close-grained, moderately hard, susceptible of a fine polish; largely used in cabinet-making, for turnery, and wooden ware; the variety with undulating grain known as "curled maple" is highly valued. A large tree; generally in swamps. Common in all the forests east of the Mississippi River.

52. *Acer saccharinum*, Wang. (Sugar Maple. Rock Maple.) Northern New Brunswick to the western shores of Lake Superior; southward through the Northern States and along the Alleghany Mountains to Georgia; west to Minnesota, Eastern Nebraska, and Arkansas. Most common at the North. Wood hard, close-grained, smooth, compact, susceptible of a fine polish; extensively used for flooring, cabinet-work, and turnery; preferred for shoe lasts. Two accidental forms, "curled maple and bird's-eye maple," are highly valued for cabinet work. A tree 60 to 80 feet in height, with a trunk 2 to 4 feet in diameter; in uplands. Maple sugar is principally made from the sap of this species; the ashes of its wood are rich in alkali, yielding large quantities of potash.

*Var. nigrum*, Torr. and Gray. *A. nigrum*, Michx. f. (Black Sugar Maple.) Western Vermont to Missouri, and south to? A large tree; along streams in lower situations than the species, from which it is perhaps specifically distinct.

53. *Negundo aceroides*, Mœnch. *Acer negundo*, L. (Box Elder. Ash-leaved Maple.) Shores of Lake Champlain, in Vermont, near Ithaca, New York, Eastern Pennsylvania, and south to Florida and Southern Texas; northwest to Wisconsin, Minnesota, and the Saskatchewan in latitude 54° N.; west to the Wasatch Mountains, Utah, New Mexico, and Arizona. Wood soft and of little value. A tree 30 to 50 feet in height, with a trunk rarely 2 feet in diameter; along streams.

54. *Negundo Californicum*, Torr. and Gray. (Box Elder.) California, northward in the coast ranges to? A small tree. Common along streams.

ANACARDIACEÆ.

55. *Rhus metopium*, L. (Coral Sumac. Mountain Manchineel. Bumwood.) Southern Florida and through the West Indies. A small tree; like many of the genus, poisonous to the touch.

56. *Rhus typhina*, L. (Staghorn Sumac.) From Northern New England south to Georgia, and west to Wisconsin, Arkansas, and Louisiana. Wood orange-colored, aromatic, brittle. A small tree, rarely 30 feet in height, or more often a shrub; leaves and bark astringent, rich in tannin.

57. *Pistacia Mexicana*, HBK.—Near the mouth of the river Pecos, Western Texas (Bigelow), and southward into Mexico. A small tree.

LEGUMINOSÆ.

58. *Robinia Pseudacacia*, L. (Locust.) Southern Pennsylvania, southward along the Alleghany Mountains to? west to? Now extensively naturalized in all the Eastern States. Wood reddish, greenish yellow, or white, according to locality; very hard, strong, and impervious to decay; largely employed in naval architecture for posts, construction, and turnery; preferred to all other woods for treenails, and in this form largely exported. A tree 70 to 80 feet in height, with a trunk 3 to 4 feet in diameter.

59. *Robinia viscosa*, Vent. (Clammy Locust.) In the high mountains of the Carolinas and Georgia, west to? Wood said to possess the same qualities as that of the last species. A tree 40 to 50 feet in height.

60. *Olneya tesota*, Gray. (Arbol de Hierro.) Common in the valleys of the lower Colorado and Gila rivers, southwestern Arizona, and the adjacent portions of California. A small tree.

61. *Piscidia erythrina*, L. (Jamaica Dogwood.) Southern Florida, and through the West Indies to Central America. "Wood heavy, hard, and resinous, coarse, cross-grained, and of a light brown color; it is very durable either in or out of water."—Nuttall. A small tree; a tincture prepared from the bark is an intense narcotic.

62. *Cladrastis tinctoria*, Raf. *Virgilia lutea*, Michx. f. (Yellow Wood.) From Central Kentucky, on the banks of the Kentucky River, south to Middle and Eastern Tennessee. Wood of a clear yellow color, said to split with difficulty and to make valuable fuel. A small or medium-sized tree; principally along streams, or on rich hill sides. Rare and in danger of extermination for fuel.

63. *Sophora affinis*, Torr. and Gray. *Styphnolobium affine*, Walp.—"Prairies of Arkansas on the Red River;" Eastern and Southern Texas. "A small tree, 10 to 12 feet in height, the trunk 4 to 8 inches in diameter; rarely a small shrub; the wood very heavy."—Lindheimer. Gray, Pl. Lindh. 178.

64. *Sophora secundiflora*, Lag. *S. speciosa*, Benth.—Western shores of Matagorda Bay to Western Texas. "A small tree, about 30 feet in height; the wood yellow, hard, and heavy, called *Lignum vitæ*. Flowers showy, blue, sweet-scented, exhaling nearly the odor of violets. The tree forms small groves on the shores of Matagorda Bay, where it is the only firewood. The wood dyes yellow."—Lindheimer. Gray, Pl. Lindh. 178. An exceedingly poisonous alkaloid, to which the name of Sophorin has been given, is produced from the seed of this species.—Rothrock, Coult. Bot. Gazette, ii. 133.

65. *Gymnocladus Canadensis*, Lam. (Kentucky Coffee Tree.) From Western New York and the Province of Ontario, south to Tennessee, west to Wisconsin, Eastern Nebraska, and the Indian Territory. Wood rose-colored, close-grained, compact, very tough, with little sapwood; susceptible of a high polish, although cross-grained and difficult to season and work. Its specific gravity 0·609. A tree 60 to 80 feet in height, with a trunk sometimes 2 feet in diameter.

66. *Gleditschia monosperma*, Nutt. (Water Locust.) South Carolina to Florida, near the coast; and from Southern Illinois to Northern Alabama, Louisiana, and Eastern Texas. A small tree; in deep swamps.

67. *Gleditschia triacanthos*, L. (Honey Locust. Three-thorned Acacia.) Western Pennsylvania to Eastern Nebraska, the Indian Territory, Louisiana, and Florida; probably not east of the Alleghany Mountains. Wood hard, heavy, coarse-grained. A large or medium-sized tree; in rich bottom land.

68. *Parkinsonia Florida*, Watson, Proc. Amer. Acad. xi. 135. *Cercidium floridum*, Benth.—Southern Texas. A small tree or shrub; not to be confounded with the next species.

69. *Parkinsonia Torreyana*, Watson, Proc. Amer. Acad. xi. 135. *Cercidium floridum*, Torr. (Palo Verde. Green-bark Acacia.) Common in the valleys of southeastern Arizona and the adjacent portions of California. Wood hard, furnishing a valuable fuel. A small tree, often 30 feet in height.

70. *Cercis Canadensis*, L. (Red Bud. Judas Tree.) New York, south to Florida; west to Minnesota, Wyoming, Louisiana, and the Indian Territory. Wood hard, compact, susceptible of a good polish. A small tree, rarely exceeding 30 feet in height.

*(To be continued.)*

## CULTIVATION OF OLIVE, CAROB, AND MULBERRY TREES IN CYPRUS.

OLIVE groves in Cyprus are not so numerous as they might be; but isolated trees are frequently to be seen scattered, with carob trees, on the hills adjoining the two great mountain ranges of the island. On the spurs of the Troodos range, and in the northern slope of the range of Kerynia, they almost form a zone, at a height varying from 400 to 700 feet above the level of the sea; and though that locality appears the best suited for them, they are frequently seen also in the plains as well as the sea-shore. Many years must elapse before olive and carob trees yield any considerable profit to planters. But if, for other reasons, as for instance to promote rain, and to improve the climate, it be decided to plant more trees, olive and carob should, by no means, be lost sight of. They thrive well, and grow almost, as it were, spontaneously, in the island, and would yield, in course of time, a fair profit.

Dr. Schmas and Mr. Galizin mention in their report that the inhabitants do not appear to take much care of the existing olive and carob groves. The fruit of the olive is very small, which induces the belief that they are not properly grafted. The inhabitants of the northern slopes of the mountain range of Kerynia seem to bestow a little more care on their olives. In gathering their olives they take at least the pains of shaking, instead of striking, the branches of the trees, as is practiced in Baffo. The only reason that can be assigned for this rough usage is, that the country people of the south are compelled to gather the olives before maturity, fearing that they would be carried away by thieves, and when yet purple, shaking alone is sufficient to make them fall to the ground. It is difficult, however, to find any excuse for the setting on fire, without any apparent reason, olive and carob trees, as witnessed on more than one occasion. The art of extracting oil from olives is far from being fully developed in Cyprus; but even if some better method were introduced, good oil could never be obtained from olives artificially ripened by baking, as practiced in Baffo. This branch of agriculture in Cyprus is capable of great improvement. Neither the quality nor the quantity of the oil now taken is such as to admit of exportation; the whole produce, a short time back, was only 103,114 gallons.

The carobs of Baffo are, unlike the olives, better than those of Kerynia, the former having sugar round the seed, and keeping better than the latter, which have but honey. Cyprus is renowned for its carob groves. The tree, unlike that of Malta, has the trunk straight, and is not so knobby. Not being sheltered, winds damage it to such an extent, that in several parts of the island, especially near the sea coast, the bending of the trunks of the trees is taken to indicate the direction of the prevailing winds. The carob of Kerynia is subject to a disease which reduces the inside of the pod to dust. It appears that it attacks, also, the carob on the sea-shore. Unlike the olive, the carob bears the heat wonderfully, and this accounts for the greater number of carob than of olive groves. Its cultivation, however, bears no proportion to the vast extent of the island and to the climate, which is so favorable to its growth. The largest production of carobs is in the districts of Limassol, Karpas, and Kerynia. The whole of the produce of the island some years ago was about 5,000 tons, of which about 1,500 tons were exported.

Mulberry trees are generally cultivated in proximity to villages, for the leaf, which is the food of the silkworm. They thrive well. At Famagusta or rather at Varoscia, where mulberries are extensively cultivated, it is calculated that a scala yields food for silkworms, producing from 12 to 16 okes of silk a year (from 33 to 44 lb.). The silk trade at present is not in a very flourishing condition, owing to a disease of the silkworm, from the effects of which the island has been suffering for the last twenty years, notwithstanding the change of seed. Cyprus produced formerly between 70,000 and 80,000 lb. of silk, while at present the yearly produce is estimated at from 5,000 to 8,400 lb. It is for the most part produced in the districts of Famagusta, Baffo, Larnaka, and Karpas. Kythrea also gives a good supply of silk, but of an inferior quality. It is calculated that 10 okes of cocoons give one oke of silk thread.

## POULTRY IN FRANCE.

FRANCE raises about 40 millions of hens, which, at the average price of 2s., represents £4,000,000; of these 40 millions, about one-fifth are annually consumed, producing meat worth about 20 million francs. Each year five million cocks are also prepared for food, which, taking the same price of 2½ francs, gives a second meat product worth 12½ million francs.

The 40 millions of hens raise annually 100 millions of chickens, from which about 10 millions of producers are obtained to replace those sacrificed for the table.

Assuming accidents and disease carry off one-tenth, there remains for sale 80 millions of chickens, which, sold at 1½ francs each, gives a third profit of 120 million francs.

In order to be precise, we must add to these figures another seven million francs for the value of capons and hens fattened. We have, therefore, a total of 153½ million francs. But this is not all. The 40 million hens will lay on an average 100 eggs each yearly, which makes a total of four milliards of eggs, which at the price of ·06 cent, or a halfpenny each, represents 240 million francs. Thus the products of fowls in the poultry yards of France make up a commercial value of nearly 400 million francs (£16,000,000). —*Bulletin de la Société d'Agriculture de Caen.*

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